

STANDARDS DEVELOPMENT BRANCH 0102E



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1987 AIR QUALITY  
DATA SUMMARY  
REGIONAL MUNICIPALITY  
OF NIAGARA

JUNE 1989



Environment  
Ontario

Jim Bradley  
Minister

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1987 AIR QUALITY DATA SUMMARY  
REGIONAL MUNICIPALITY OF NIAGARA

Report prepared by:

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WEST CENTRAL REGION

JUNE 1989

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## INTRODUCTION

This report summarizes the results of air monitoring in the Regional Municipality of Niagara in 1987.

The Ministry of the Environment has conducted routine monitoring in the area since the early 1970's. The Air Management Program in Ontario is based on controlling man-made emissions to meet ambient air quality objectives, which in turn are based on known effects on health, quality of life or sensitive vegetation, whichever is most stringent. To achieve these objectives, sources of pollution are identified, their emissions evaluated and appropriate control measures are instituted. Ambient air monitoring is used to identify pollution sources, evaluate the need for controls and then determine whether controls have been successful.

In addition to monitoring specific industrial sources, monitoring of a more general nature is also carried out in various localities to determine if air quality objectives are being met and to observe trends in air pollution.

## MONITORING NETWORK

The Ministry of the Environment operates a network of monitors in the Regional Municipality of Niagara in Niagara Falls, Chippawa, Port Colborne, St. Catharines, Thorold, and Welland. The Air Pollution Index (API) was measured in St. Catharines and Niagara Falls and was used as a warning system to alert the public to elevated air pollution levels. It was derived from 24 hour average concentrations of sulphur dioxide and particulate matter measured at single monitoring stations in those cities. The combination of these two pollutants at high concentrations has been shown to be indicative of adverse health effects. Hourly concentrations of both pollutants were telemetered to a central computer facility in Toronto which then calculated the index, a dimensionless number based on the following mathematical equations:

### St. Catharines

.97

$$API = 1.15 (16.84 COH + 138.4 SO_2)$$

### Niagara Falls

.92

$$API = 1.47 (15.74 COH + 131.7 SO_2)$$

where:

COH is the 24-hour average soiling index concentration expressed in coefficient of haze units.

SO<sub>2</sub> is the 24-hour average concentration of sulphur dioxide expressed in parts per million.

Values below 32 are considered acceptable. At 32, known as the advisory level and with a forecast of continued unfavorable weather conditions, significant industrial sources may be asked to voluntarily curtail operations. At

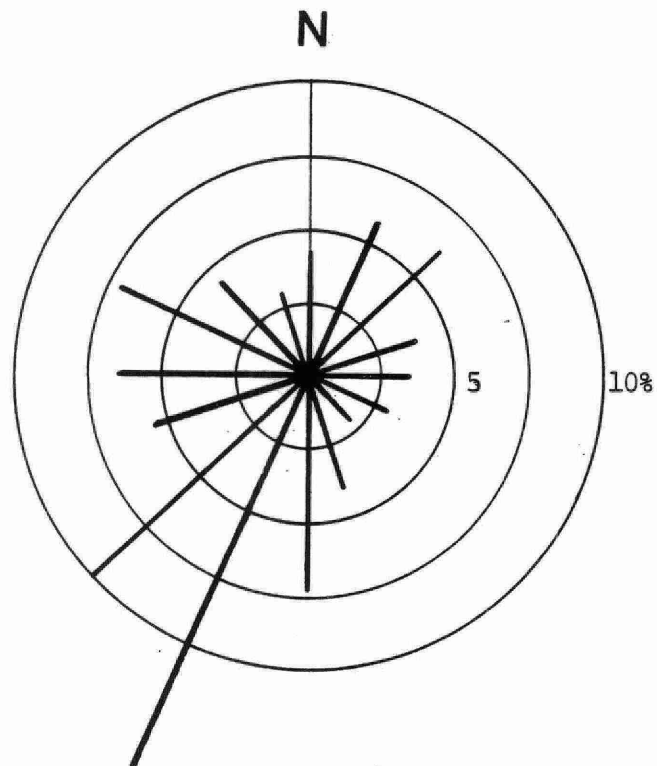
an API of 50, major emitters would be ordered by law to curtail some operations. At 75, further cutbacks would be required and at 100, all sources not essential to the public health and safety could be ordered to cease operations.

Meteorological data (wind and temperature) were measured near Allanburg. Figure 1 illustrates the wind frequency distribution for the area and shows that winds from the west and southwest quadrants predominate. Consequently, wherever possible, fixed stations are normally located "downwind" of suspected pollution sources with respect to these wind directions.

Wind data were utilized in a computer program known as a "pollution rose" - essentially a cross-tabulation of average hourly pollutant concentrations with wind direction. The data from this program are illustrated on various maps in this report and are a useful tool in determining the impact of any given source on a monitoring station. The length of each line of the "rose" is proportional to the average yearly concentration when the wind was blowing from that direction.



FIGURE 1  
WIND FREQUENCY DISTRIBUTION 1987  
27011 - ALLANBURG



Lines indicate direction wind blew from

POLLUTANTS MONITORED

Two basic types of air pollutants are measured-gases and particulates (dust).

a) Gases measured with continuous analyzers include:

-Sulphur Dioxide (SO<sub>2</sub>) - usually monitored near industrial sources but SO<sub>2</sub> is also a product of domestic space heating. Air quality objectives and their limiting factors are:

1-hour average - .25 ppm (vegetation effects)  
24-hour average - .10 ppm (health effects in conjunction with particulates)  
1-year average - .02 ppm (vegetation effects)

-Total Reduced Sulphur (TRS) - measured exclusively near industrial sources. The measurement includes hydrogen sulphide (H<sub>2</sub>S), the "rotten egg" gas but also other sulphur compounds. There are no general objectives for TRS but a one-hour objective of 20 ppb exists for H<sub>2</sub>S (given below). However, H<sub>2</sub>S can actually be smelled at 10 ppb or less. There is also a one-hour TRS objective of 27 ppb, however, it is restricted only to areas near Kraft pulp mills.

1-hour average - 20 ppb (odour)

-Carbon-Monoxide-(CO) - measured for general ambient levels in St. Catharines. The major source of CO is the automobile. Objectives for CO are:

1-hour average - 30 ppm (health effects)  
8-hour average - 13 ppm (health effects)

-Ozone (O<sub>3</sub>) - measured in St. Catharines to check general ambient levels. Oxidants are products of photochemical reactions involving oxides of nitrogen, hydrocarbons and sunlight. Ozone accounts for most of the oxidants produced. The sources of the precursor pollutants are mainly industrial and automotive. Concentrations follow very definite annual and daily trends with highest levels occurring during the summer, and daily maxima occurring in mid-afternoon. Both patterns are directly related to temperature and the amount and intensity of sunlight. Ozone and its precursors can be transported over great distances and can be augmented by local sources. Most of the high levels measured in Southern Ontario each summer arrive from the United States. An objective for ozone is:

1-hour average - 80 ppb (vegetation effects)

-Oxides of Nitrogen - general ambient levels were measured in St. Catharines. They are a products of high temperature combustion sources including the automobile. The most abundant oxides are nitric oxide (NO and nitrogen dioxide (NO<sub>2</sub>). Objectives exist only for NO<sub>2</sub>:

1-hour average - .20ppm. (odour)

24-hour average - .10 ppm (health effects)

- b) Particulates (dust) are measured by three methods, each relating to a different size range of particles.

-Dustfall - heavy material generally greater than 10 microns in size (one micron is one-millionth of a metre) that settles out of the atmosphere by gravity. A plastic container is exposed for one month and the collected dust is weighed and expressed as a deposition rate of grams/square metre/30 days. The

measurement is imprecise and observations are restricted to relatively local areas. Criteria are:

1-month average -  $7.0 \text{ g/m}^2/30 \text{ days}$  (nuisance effects)

1-year average -  $4.5 \text{ g/m}^2/30 \text{ days}$  (nuisance effects)

-Total Suspended Particulates (TSP) - measured with high volume (hi-vol) samplers near industrial sources and for general ambient observations. The particles range from submicron to about 50 microns in size. The hi-vol sampler draws air through a glass fibre filter for a 24-hour period. The exposed filter is weighed and the weight of solids collected is converted to an equivalent concentration in air expressed in micrograms per cubic metre. The samplers run once every six days. Criteria based on health effects in conjunction with sulphur dioxide are:

24-hour average -  $120 \text{ ug/m}^3$  (health effects)

1 year geometric mean -  $60 \text{ ug/m}^3$  (health effects)

-Soiling Index (Coefficient of Haze) - measured by tape samplers which measure fine particles less than 10 microns. Industrial sources as well as general ambient air are monitored. Coefficient of haze tape samplers determine hourly soiling values. Air is drawn through a filter paper tape for one hour. A beam of light is shone through the paper before and after the airborne particles are collected. The difference in light transmission is translated into a coefficient of haze (COH) unit. The paper tape then advances and a new hourly sample is collected. The criteria shown below are based largely on correlations with total suspended particulate (TSP).

24-hour average - 1.0 COH's/1000 linear feet of air  
1-year average - .5 COH's/1000 linear feet of air

## DATA ANALYSIS

### Niagara Falls

The Air Pollution Index (API) Station (27056) on Allendale Avenue, near the Falls tourist area (Figure 2) reached a maximum API of 16 on October 17, well below the advisory level. Elevated pollutant levels were widespread on this day as the Hamilton and St. Catharines APIs were also elevated. Normally however, the API was very low, averaging only 4 for the year.

Sulphur dioxide and soiling index concentrations at the Allendale Avenue station 27056 (Table 1) were generally low and met all objectives. Figures 3 and 4 show the yearly trends for these two parameters at the API station dating back to 1980. Little change in levels is evident.

The pollution rose given in Figure 5 for sulphur dioxide shows the highest average for east winds indicating a small influence of the Niagara Falls, New York industrial area. For soiling index in Figure 6, highest levels were from the southeast quadrant. This may indicate a small influence of traffic in the Falls tourist area.

Suspended particulates (TSP) at API station 27056 were generally low and met the yearly objective (Table 1). The daily objective was exceeded one time out of 58 samples, on May 9, the day of a windstorm which caused high TSP's throughout Southern Ontario. The trend of TSP dating back to 1980 is given in Figure 7 and shows a gradual decline in levels since that time to well below the yearly objective.

Station 27055 at Stanley St., Niagara Falls, 500 metres northeast of General Abrasive Ltd., (Figure 8) completed its fourth full year of monitoring in 1987. The station contains

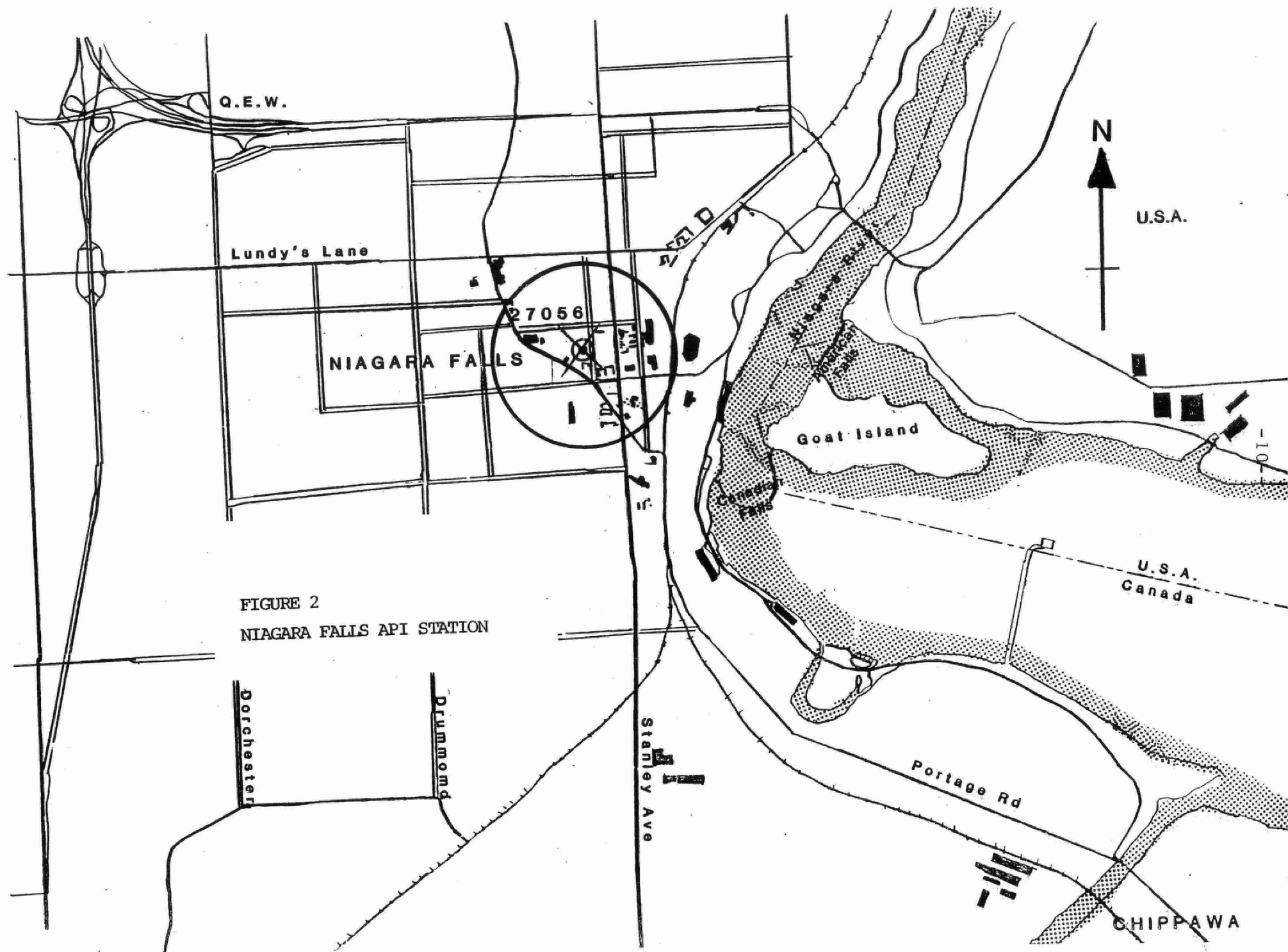


FIGURE 2  
NIAGARA FALLS API STATION

**TABLE 1**

**SUMMARY STATISTICS - NIAGARA FALLS**

**CONTINUOUS POLLUTANTS**

**27056 - ALLENDALE AVE**

POLLUTANT	ANNUAL AVERAGE			1987 MAXIMUM		OBJECTIVE		1 YR	NO. TIMES OVER OBJECTIVE(1987)		
	1985	1986	1987	1 HR	24 HR	1 HR	24 HR		1 HR	24 HR	1 YR
SULPHUR DIOXIDE SO <sub>2</sub> (ppm)	0.003	0.003	0.002	0.14	0.03	0.25	0.10	0.02	0	0	0
SOILING INDEX COH(COH'S)	0.20	0.18	0.20		0.7		1.0	0.5		0	0

**SUMMARY STATISTICS - NIAGARA FALLS**

**CONTINUOUS POLLUTANTS NEAR GENERAL ABRASIVE LTD.**

**27055 - STANLEY AVE**

POLLUTANT	ANNUAL AVERAGE			1987 MAXIMUM		OBJECTIVE		1 YR	NO. TIMES OVER OBJECTIVE(1987)		
	1985	1986	1987	1 HR	24 HR	1 HR	24 HR		1 HR	24 HR	1 YR
SULPHUR DIOXIDE SO <sub>2</sub> (ppm)	0.006	0.008	0.006	0.11	0.04	0.25	0.10	0.02	0	0	0
SOILING INDEX COH(COH'S)	0.33	0.34	0.35		1.2		1.0	0.5		1	0
TOTAL REDUCED SULPHUR (TRS) (ppb)	1.6	1.2	2.8	87		20(H <sub>2</sub> S)			131 481 hours	10ppb	

**SUSPENDED PARTICULATES - micrograms per cubic metre**

**ONT. OBJECTIVES: 120 (24 hour)  
60 (annual geo. mean)**

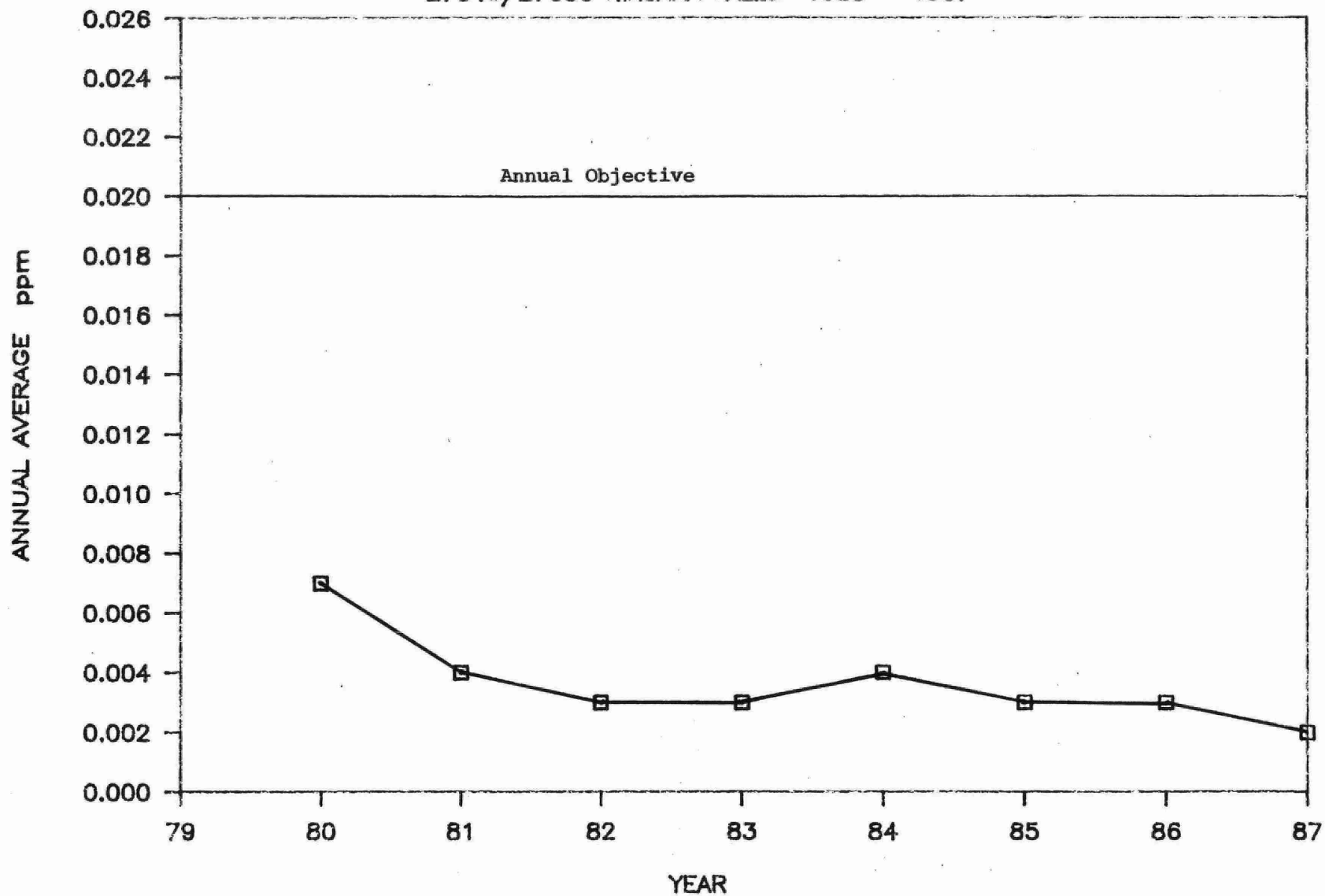
STATION	GEOMETRIC MEAN			1987 MAXIMUM 24 HR	NO. OF SAMPLES	NO. TIMES OVER OBJECTIVE(1987)		SOURCE MONITORED
	1985	1986	1987			24 HR	1 YR	
27056 ALLENDALE AV	44	42	44	125	58	1	0	AMBIENT
27055 STANLEY AV	79	81	85	258	51	14	1	GENERAL ABRASIVES
27050 VICTORIA AV	67	*90	73	274	56	5	1	CYANAMID

\* Station moved to 27050 from 27053(First & Bridge) in early 1986.



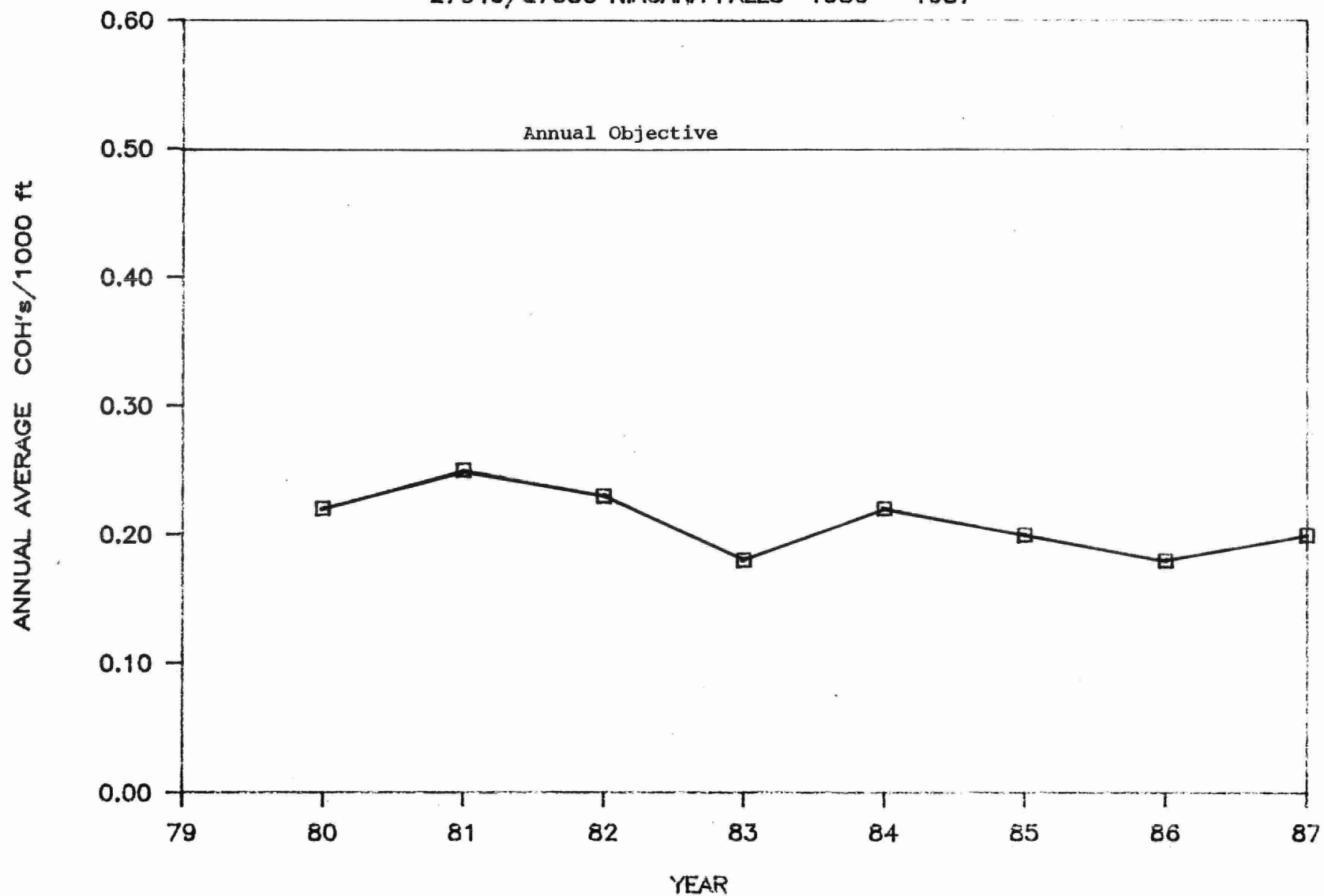
# FIGURE 3 SULPHUR DIOXIDE YEARLY TREND

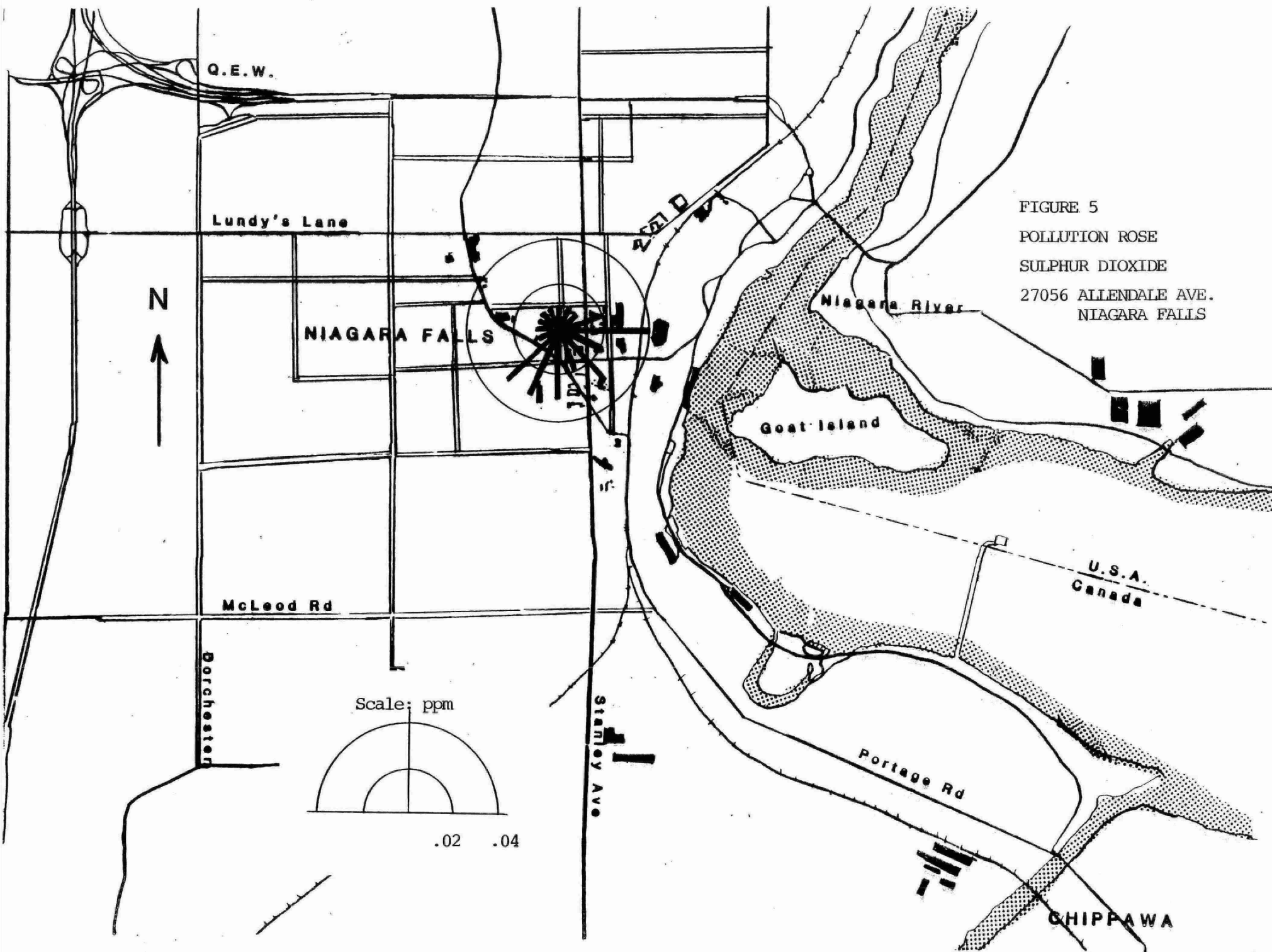
27049/27056 NIAGARA FALLS 1980 - 1987



**FIGURE 4**  
**SOILING INDEX YEARLY TREND**

27049/27056 NIAGARA FALLS 1980 - 1987





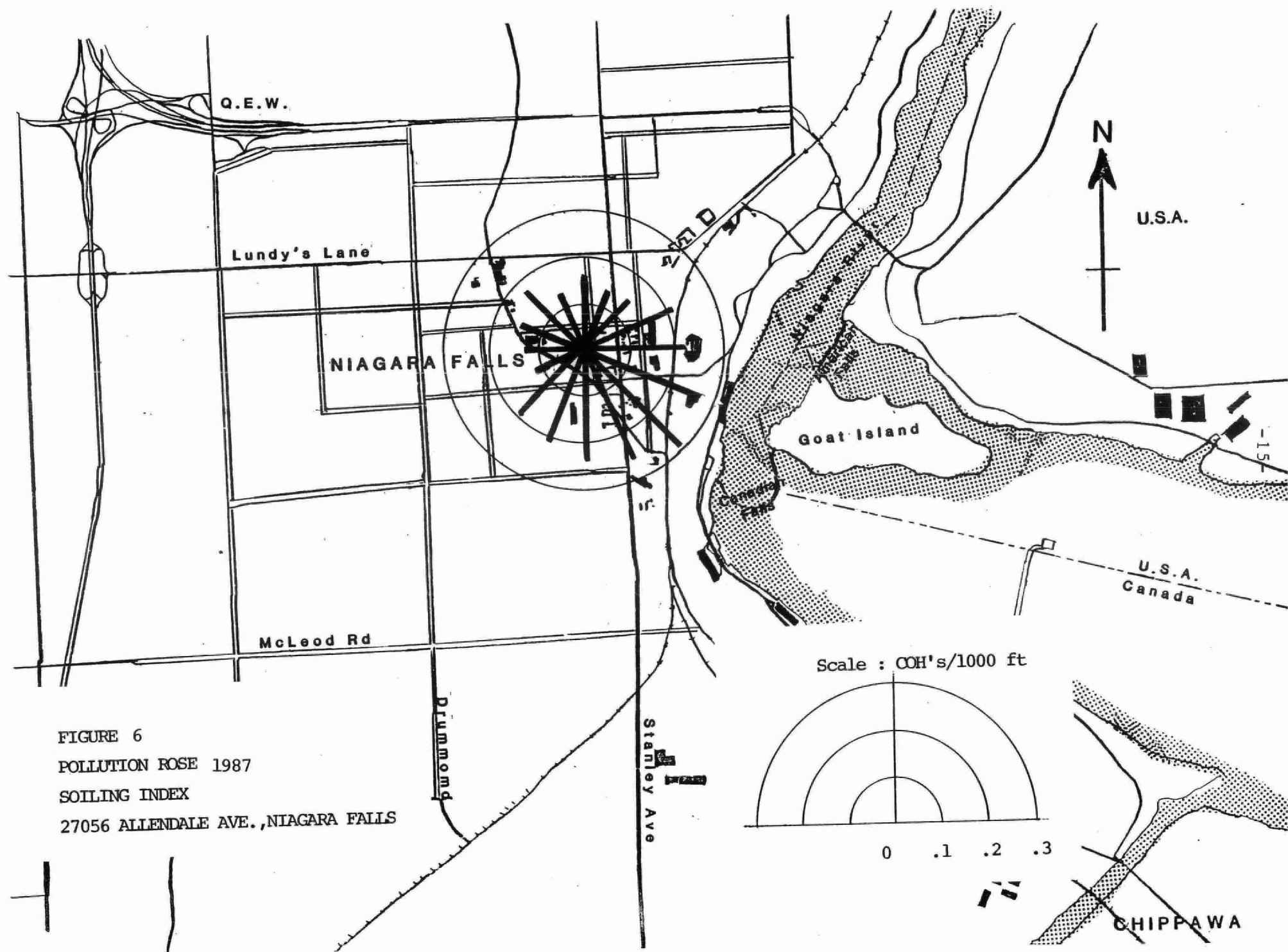


FIGURE 6  
 POLLUTION ROSE 1987  
 SOILING INDEX  
 27056 ALLENDALE AVE., NIAGARA FALLS

# FIGURE 7 SUSPENDED PARTICULATES YEARLY TREND

27049/27056 NIAGARA FALLS 1980 - 1987

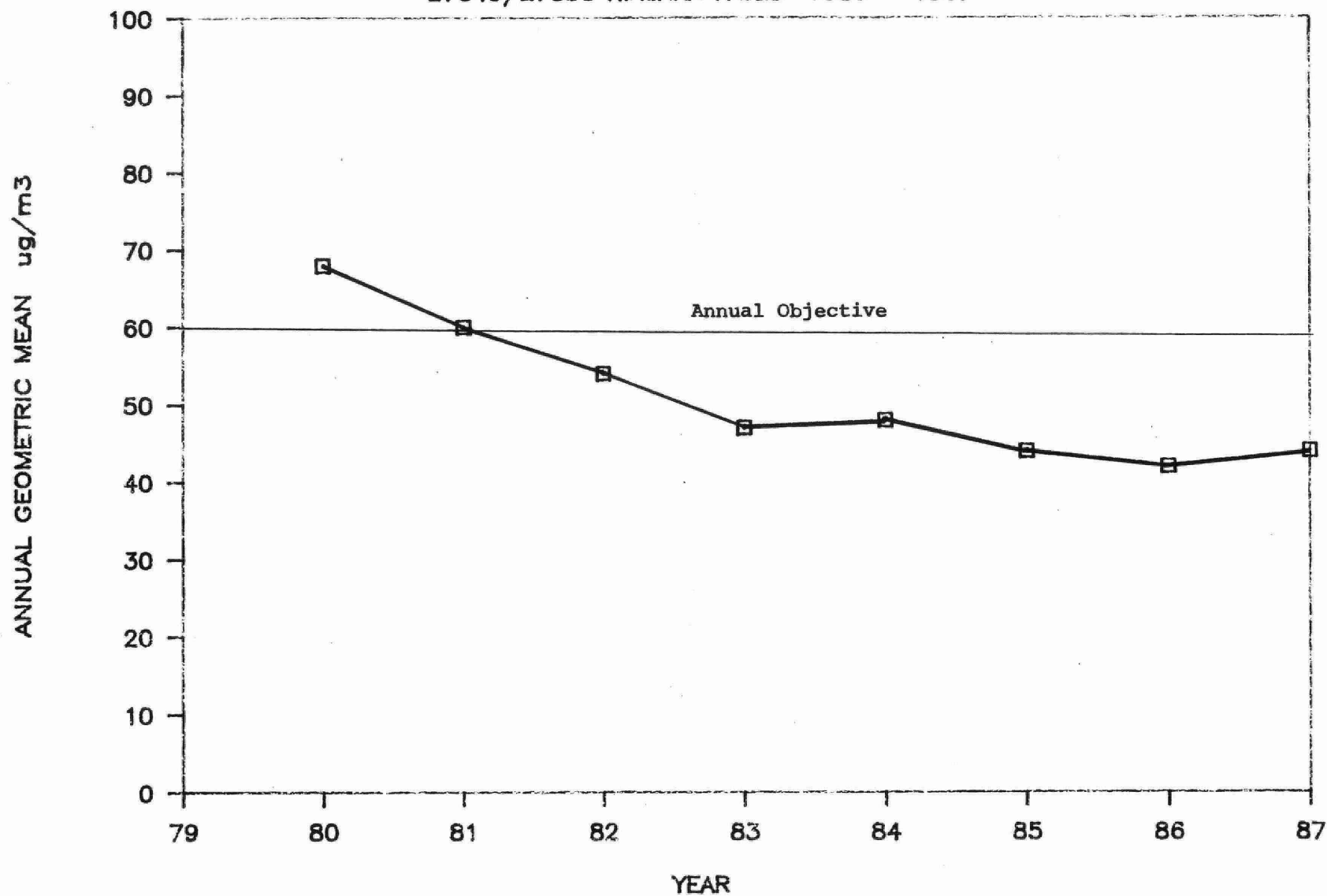


FIGURE 8  
NIAGARA FALLS INDUSTRY STATIONS



(SO<sub>2</sub>) and total reduced sulphur (TRS) continuous analysers, a soiling index tape sampler and a hi-vol.

The data for SO<sub>2</sub> is summarized in Table 1 and show mostly low levels. All objectives for sulphur dioxide were met. In the case of TRS, a severe deterioration was noted. There were 131 hours in which the objective for hydrogen sulphide was exceeded (Table 1), compared to 26 in 1986. The data can also be compared to the 10 ppb level - an approximate odour threshold for hydrogen sulphide. There were 481 hours above this level in 1987, compared to 143 in 1986. Figure 9 depicts the severe deterioration in TRS measured in 1987 which was mainly due to increased production rates and changes to process operations.

The pollution roses in Figures 10 and 11 confirm that General Abrasives was the primary source of both pollutants as both roses show peaks under south-southwest winds. For sulphur dioxide, a slight importation from the U.S. from the east-southeast was also evident. As well, for TRS, peaks from the north-northeast and east-southeast occurred. These may indicate contributions from the Niagara Falls waste water treatment plant and the U.S. respectively.

The major sources of odours at the General Abrasives plant are the silicon carbide furnaces. The company has conducted stack testing and is continuing to modify their control system which consists of a baghouse and incinerator for collection of dust and TRS. The control system when installed in 1985, was a new design concept. However, modifications are required and the company is in the midst of a three phase voluntary program of which Phase 1 was completed in October, 1988. This phase will include improved capture and incineration of TRS. The success of this work will determine whether the more complex design changes in phase 2 and 3 will be implemented.

**FIGURE 9**  
**TRS EXCEEDENCE TREND — NIAGARA FALLS**  
**HOURS OVER 10 PPB AT GENERAL ABRASIVES**

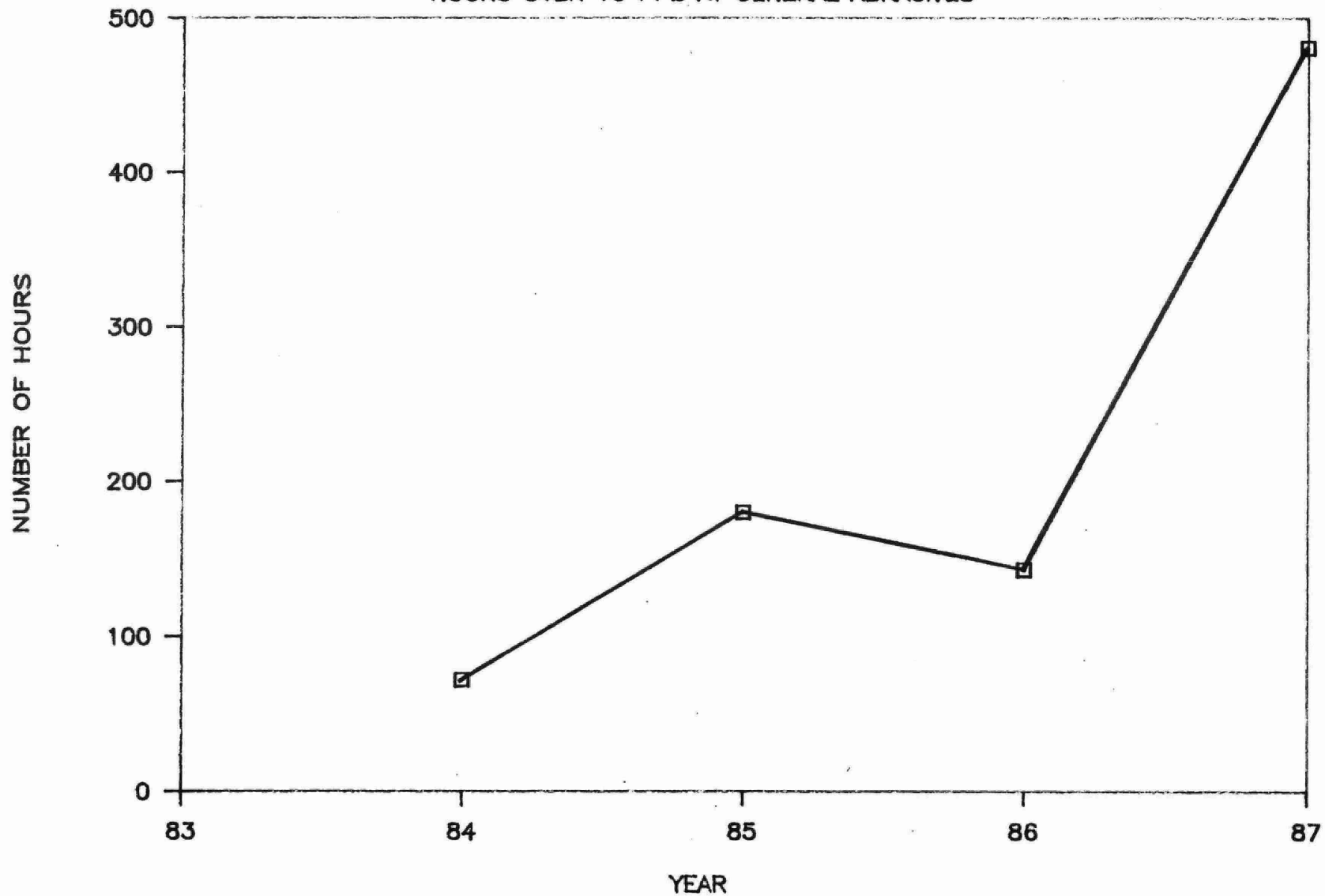
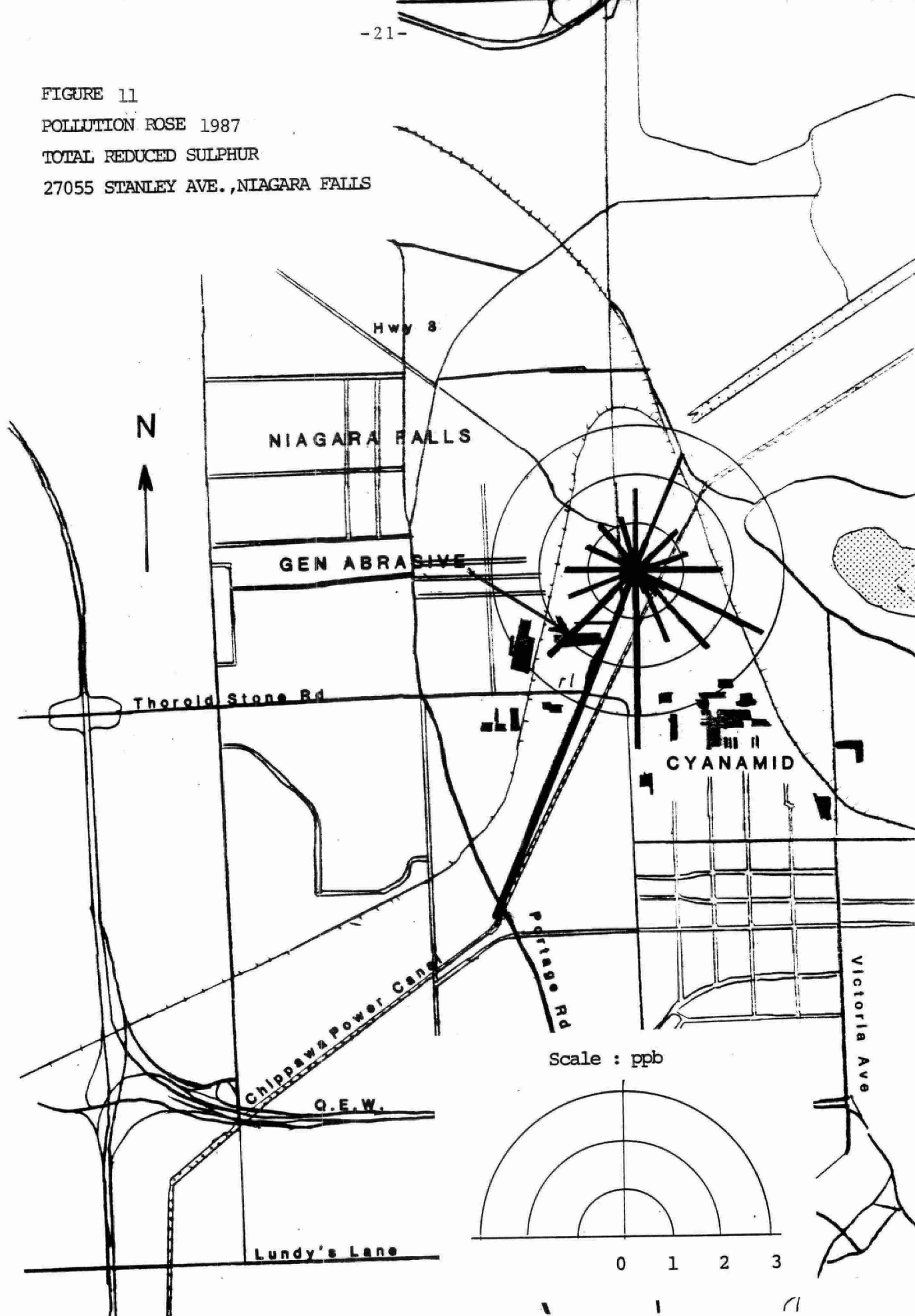




FIGURE 10  
POLLUTION ROSE  
SULPHUR DIOXIDE  
27055 STANLEY AVE., NIAGARA FALLS



FIGURE 11  
POLLUTION ROSE 1987  
TOTAL REDUCED SULPHUR  
27055 STANLEY AVE., NIAGARA FALLS



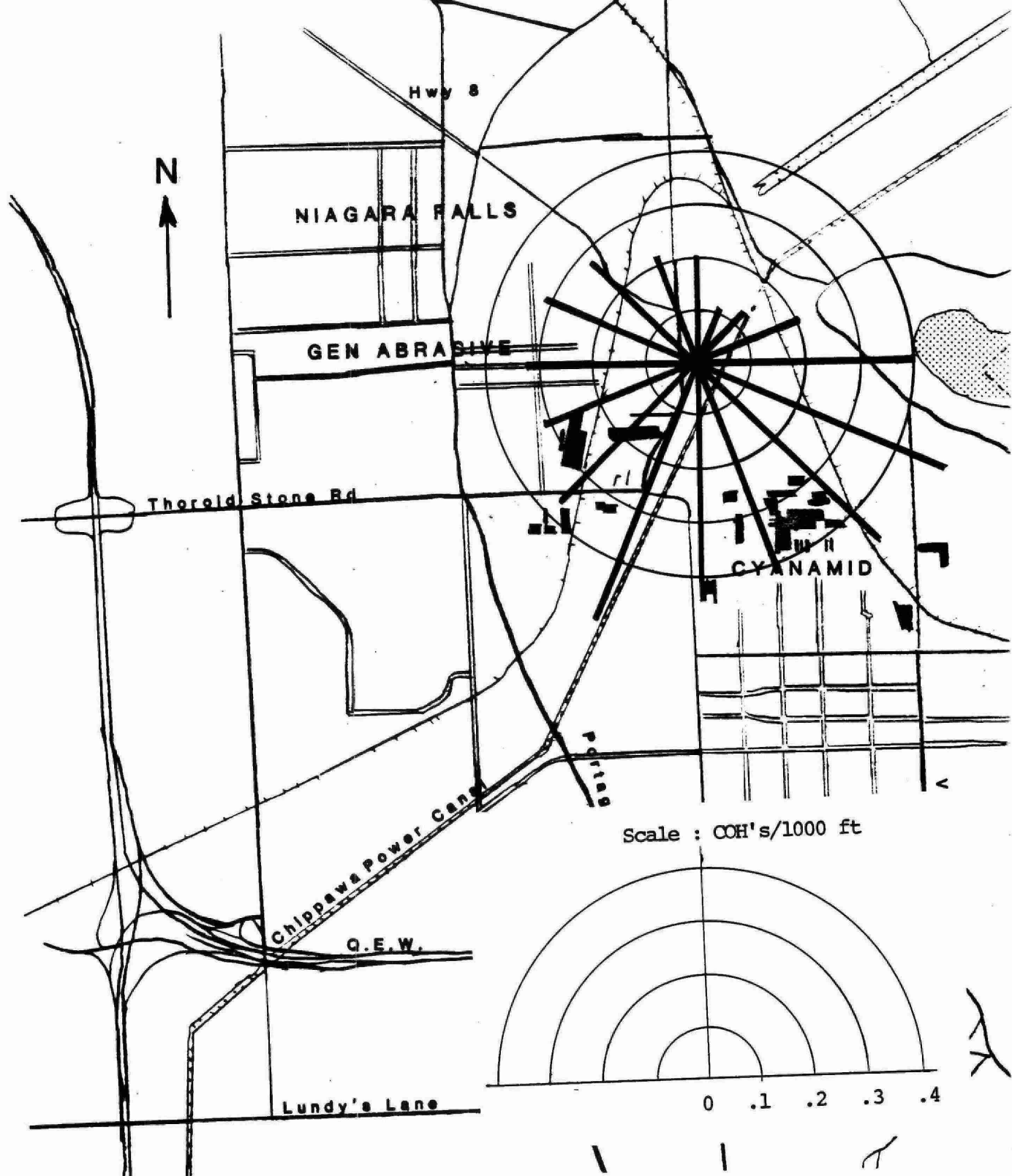
The hi-vol at station 27055 (Stanley St.) measuring suspended particulates continued to show unacceptably high levels. The yearly mean increased slightly to  $85 \text{ ug/m}^3$ , well above the objective of 60, and 14 out of 51 samples (27%) exceeded the daily objective of  $120 \text{ ug/m}^3$  compared to 16% in 1986 (Table 1). The data were correlated with wind direction and correlated fairly strongly with southwest winds, indicating that General Abrasives was the main source of the dust.

The major sources of dust emissions are the product handling operation for the aluminum oxide furnaces. The latter operations were redirected into the existing control systems in the spring of 1988. Another product handling operation's emissions will also be redirected into the control systems in 1989.

The soiling index tape sampler at 27055 (Stanley St.) which measures much finer particles than the hi-vol showed much lower concentrations (Table 1) usually within criteria. The daily objective was exceeded only once and the yearly average was well below the objective. The pollution rose in Figure 12 indicates a small contribution of fine particles from General Abrasive under south-southwest winds, however, equivalent levels came from the southeast quadrant (either from Cyanamid or the U.S.). Fallout from this plant would appear to consist primarily of larger particles affecting a very localized area.

Suspended particulates were measured at Station 27050 on Victoria Avenue 500 metres east of Cyanamid (Figure 8). The station was returned to this location from Station 27053-First and Bridge in early 1986. The Victoria location is more downwind of Cyanamid with respect to predominant winds. This likely accounts for the increase observed in 1986 in the yearly mean to well above the objective (Table 1). In 1987, a major improvement was observed at this station. The yearly mean fell to  $73 \text{ ug/m}^3$  (from 90) and only

FIGURE 12  
POLLUTION ROSE 1987  
SOILING INDEX  
27055 STANLEY AVE., NIAGARA FALLS



5 samples out of 56 exceeded the daily objective. As mentioned, the soiling index sampler at station 27055 northwest of the plant also seemed to show a small impact from Cyanamid (Figure 12).

The major sources of dust from Cyanamid are the calcium carbide furnace and its product handling system. The latter was controlled with new baghouses during 1987, accounting for the measured improvement. The company continued to modify other portions of their operations in 1988 in order to further reduce dust emissions.

Despite the station's proximity to Cyanamid, correlations of suspended particulate readings with wind direction did not indicate Cyanamid to be the only source of dust. No wind direction correlated strongly with the TSP data. It is likely that other fugitive dust sources nearby contributed to the readings. These sources include an adjacent helicopter landing pad and other nearby unpaved areas.

#### Chippawa

Station 27051 at Norton and Portage, 200 metres northeast of the Norton Company (Figure 13) indicated that air quality did improve, but problems near the plant still exist despite the installation of a tall stack in 1982. The station contains SO<sub>2</sub> and TRS analyzers. Hi-vol and dustfall measurements were also made in the area.

SO<sub>2</sub> and TRS data are summarized in Table 2. Although all SO<sub>2</sub> objectives were met, the one-hour objective for hydrogen sulphide (20 ppb) was exceeded 20 times during the year compared to 43 hours in 1986. Further, the TRS data can also be compared to the 10 ppb level - an approximate odour threshold for hydrogen sulphide, and 78 hours exceeded this level in 1987 compared to 306 in 1986. The trend graphs in Figures 14 and 15 show that the sulphur dioxide hourly

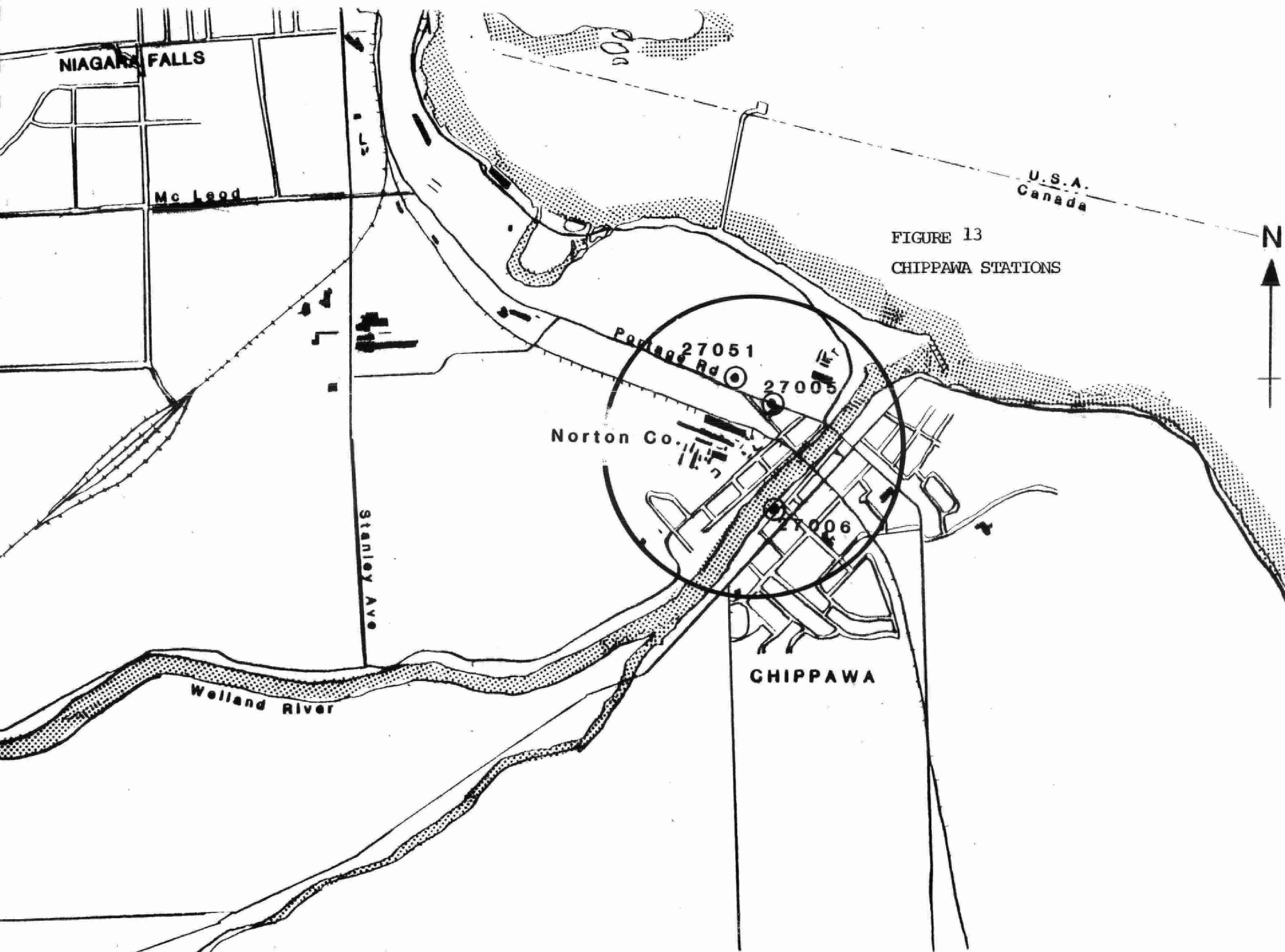


FIGURE 13  
CHIPPAWA STATIONS

TABLE 2

## SUMMARY STATISTICS - CHIPPAWA

## CONTINUOUS POLLUTANTS NEAR NORTON CO.

## 27051 - NORTON/PORTAGE

POLLUTANT	ANNUAL AVERAGE			1987 MAXIMUM		OBJECTIVE			NO. TIMES OVER OBJECTIVE(1987)		
	1985	1986	1987	1 HR	24 HR	1 HR	24 HR	1 YR	1 HR	24 HR	1 YR
SULPHUR DIOXIDE SO <sub>2</sub> (ppm)	0.005	0.005	0.005	0.06	0.04	0.25	0.10	0.02	0	0	0
TOTAL REDUCED SULPHUR (TRS) (ppb)	2.1	2.2	1.8	81		20(H <sub>2</sub> S)			20 78 hours > 10ppb		

## SUSPENDED PARTICULATES - micrograms per cubic metre

## ONT.OBJECTIVES:

120 (24 hour)  
60 (annual geo.mean)

STATION	GEOMETRIC MEAN			1987 MAXIMUM 24 HR	NO.OF SAMPLES	NO. TIMES OVER OBJECTIVE(1987)		SOURCE MONITORED
	1985	1986	1987			24 HR	1 YR	
27051 NORTON/PORTAGE	64	62	58	189	56	5	0	NORTON CO.

## DUSTFALL - grams/square metre/30 days

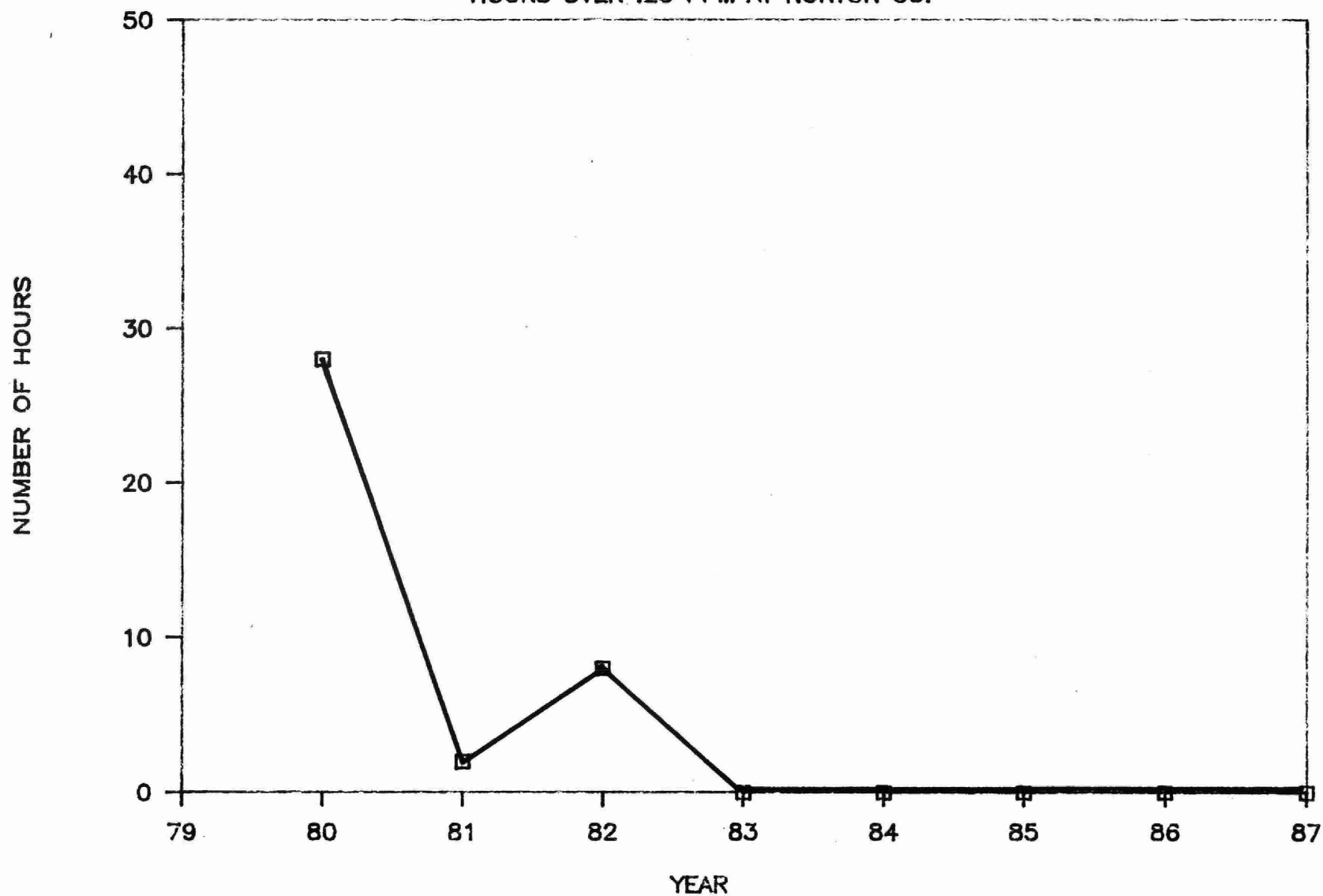
## ONT.OBJECTIVES :

7.0(1 MONTH)  
4.5(ANNUAL AVERAGE)

STATION	ANNUAL AVERAGE			1987 MAXIMUM 1 MONTH	NO. MONTHS OVER OBJECTIVE			SOURCE MONITORED
	1985	1986	1987		1985	1986	1987	
27005 PORTAGE/LEGION CHIPPAWA	6.7	8.2	7.1	11.4	5	5	6	NORTON CO.
27006 BRIDGEWATER CHIPPAWA	2.8	3.3	2.8	5.0	0	1	0	BACKGROUND

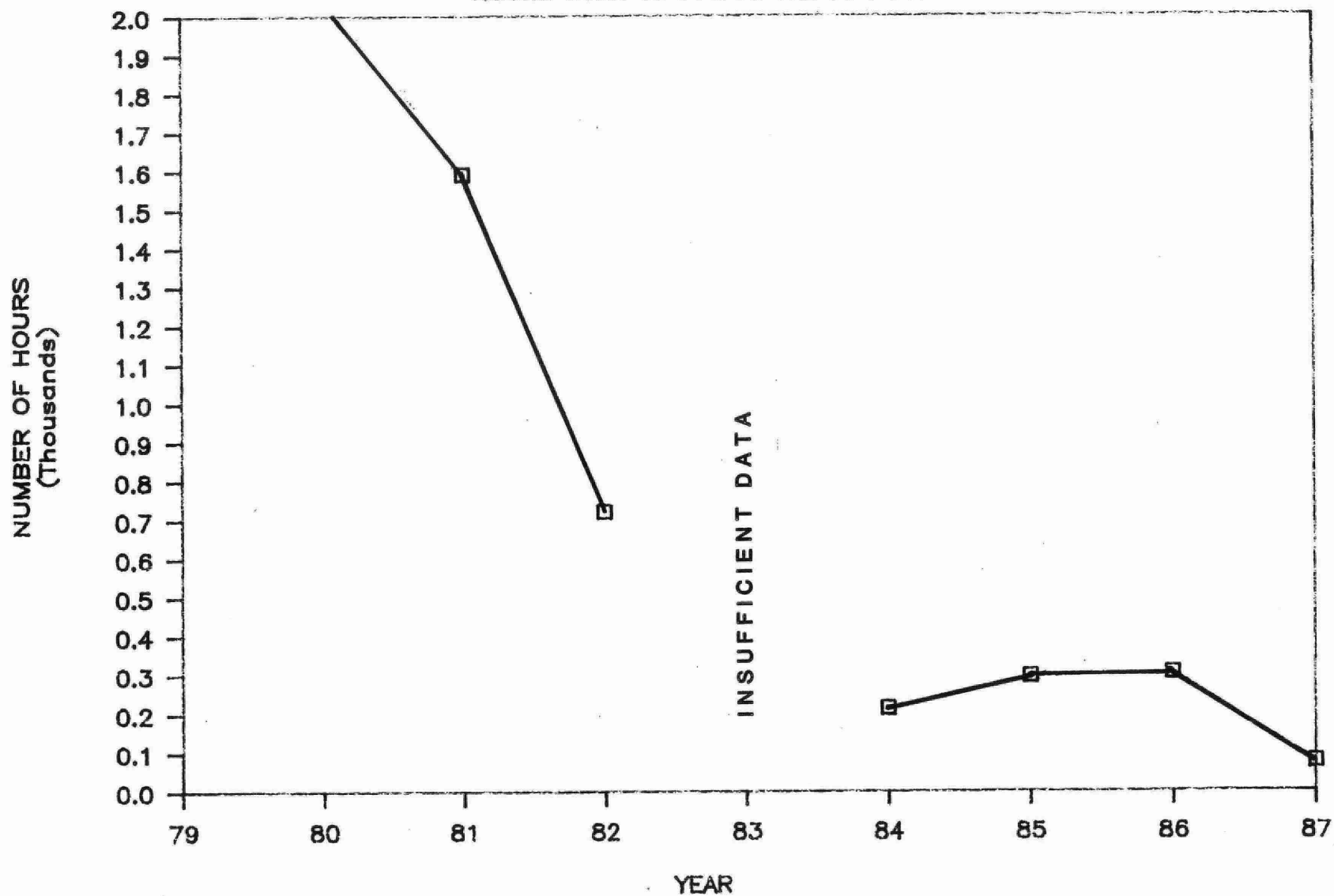
**FIGURE 14**  
**SO<sub>2</sub> EXCEEDENCE TREND — CHIPPAWA**

HOURS OVER .25 PPM AT NORTON CO.





**FIGURE 15**  
**TRS EXCEEDENCE TREND — CHIPPAWA**  
**HOURS OVER 10 PPB AT NORTON CO.**



objective has not been exceeded since 1982, and that TRS exceedences of 10 ppb have decreased dramatically since the early 1980's, when literally thousands of such exceedences were routinely measured yearly. The installation of the tall stack previously mentioned is largely responsible for this improvement. The TRS improvement in 1987 was due to improved product handling operations.

Pollution roses in Figures 16 and 17 indicate a lessening contribution of the Norton plant as both SO<sub>2</sub> and TRS roses show modest peaks under southwest winds. The remaining SO<sub>2</sub> and TRS source at Norton is the product handling system. This fugitive (non-stack) source will be controlled in 1989 by redirecting the emissions into the tall stack.

Suspended particulate concentrations were measured at Station 27051 (Table 2). The yearly mean was only 58 ug/m<sup>3</sup>, below the yearly objective, and 5 samples out of 56 exceeded the daily objective. Each exceedence occurred on south or southwest wind days and none after early July. The trend graph in Figure 18 shows the huge improvements in TSP levels dating back to 1974 due to various emission control improvements made at this plant. The remaining particulate sources at Norton are the product handling system and one of the furnace baghouses which needed replacement. That was carried out in early 1988.

Dustfall near the Norton plant at 27005, Portage and Legion (Figure 13) exceeded the monthly objective in 6 out of 12 samples (Table 2). The background jar (27006) at Bridgewater and Oliver recorded much lower and acceptable levels. Similar to TSP, dustfall levels at 27005 have improved greatly since the 1970s (Figure 19) but a dust fallout problem still existed. The major source of this problem at Norton was the previously mentioned furnace operation which had its emission control system replaced in 1988.

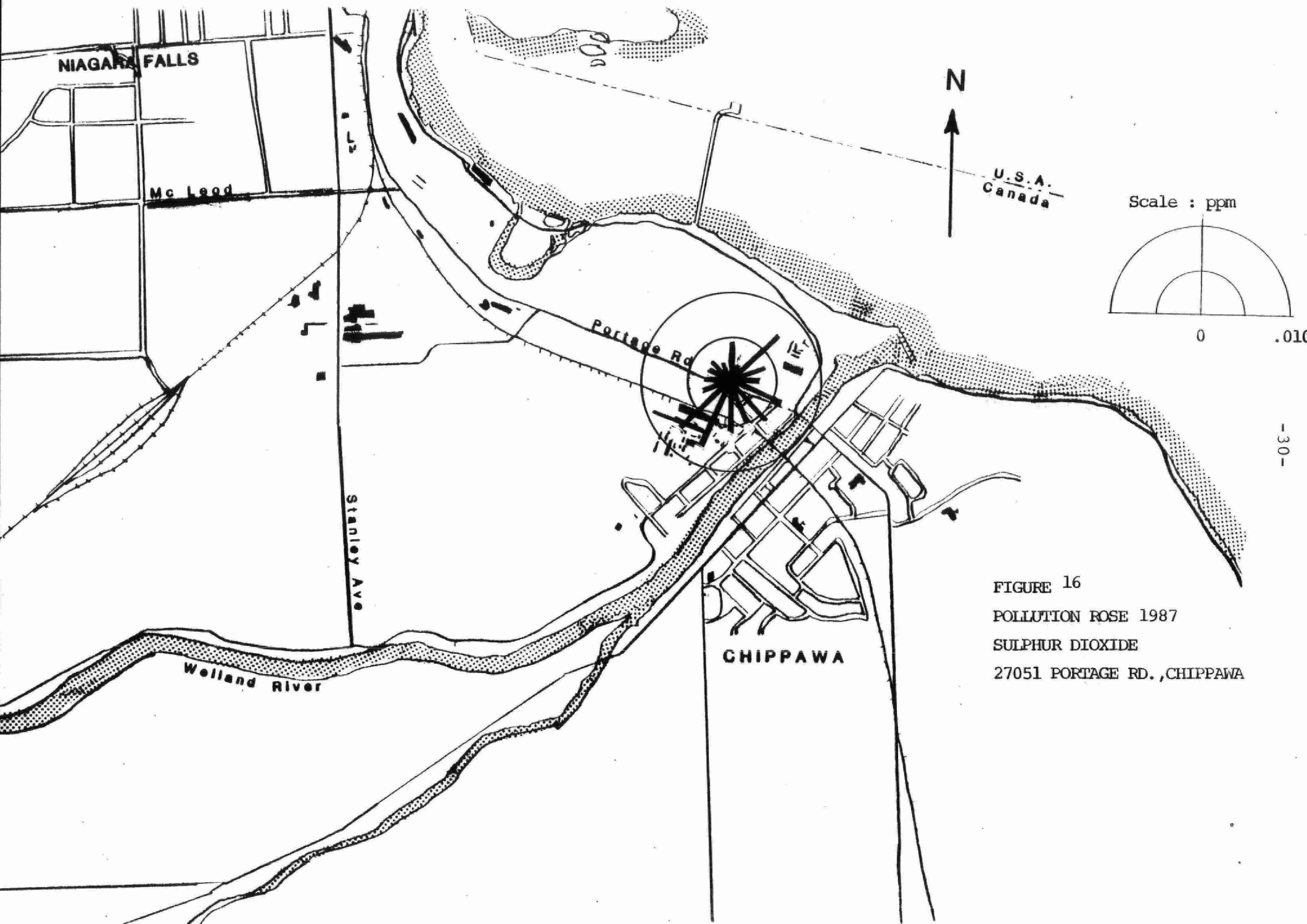
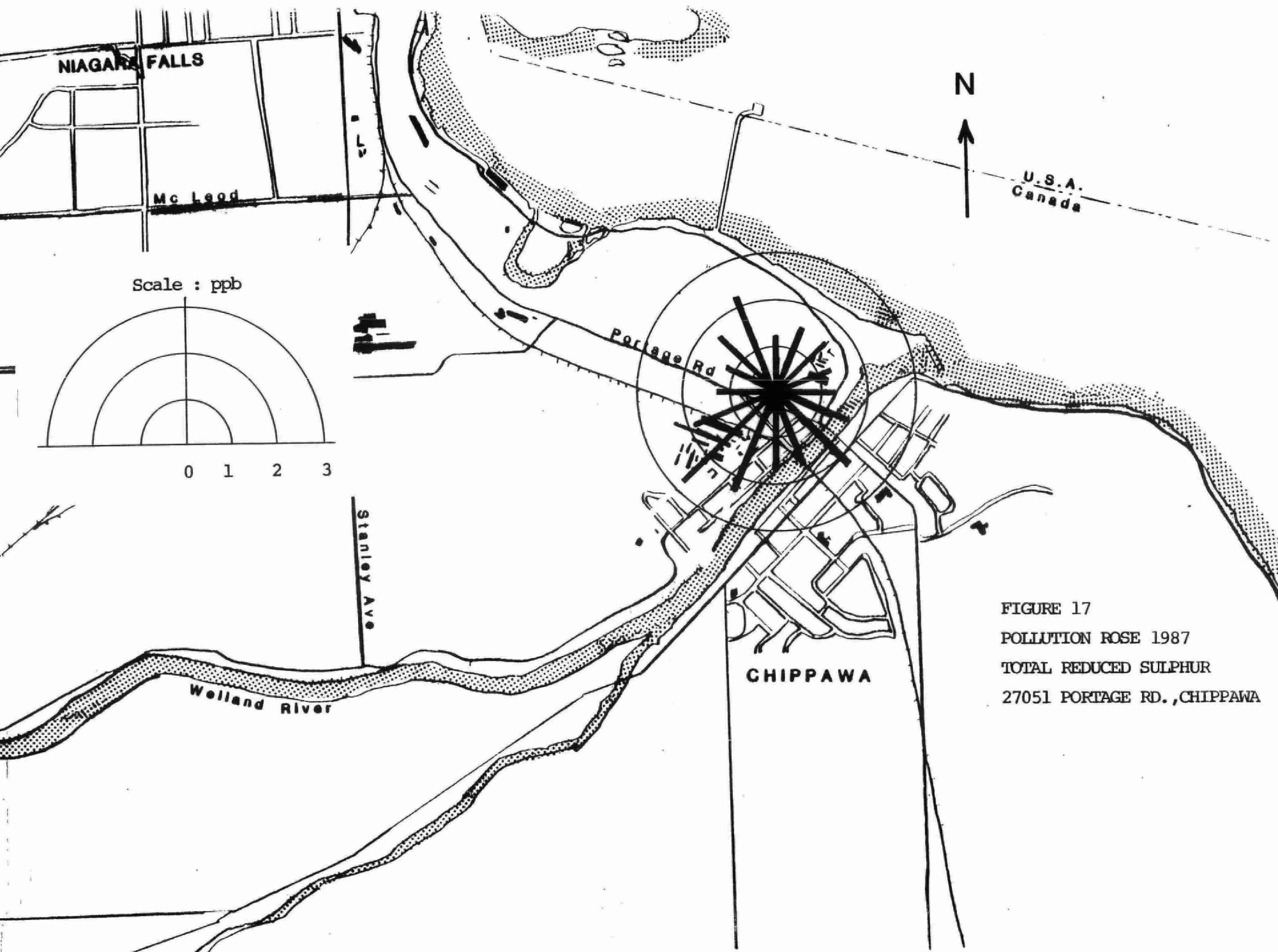


FIGURE 16  
POLLUTION ROSE 1987  
SULPHUR DIOXIDE  
27051 PORTAGE RD., CHIPPAWA



# FIGURE 18 SUSPENDED PARTICULATES YEARLY TREND

27009/51 NORTON CO., CHIPPAWA

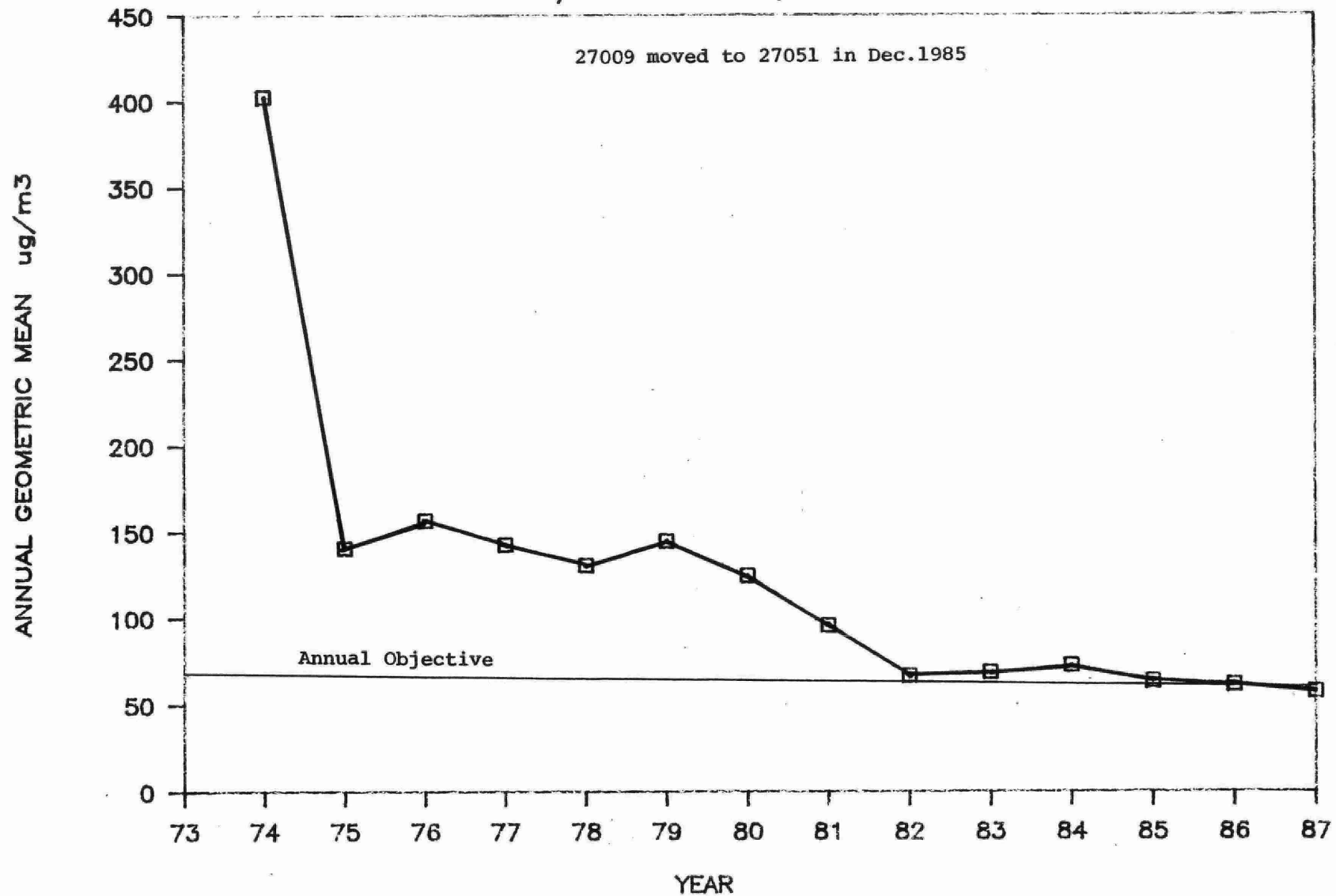
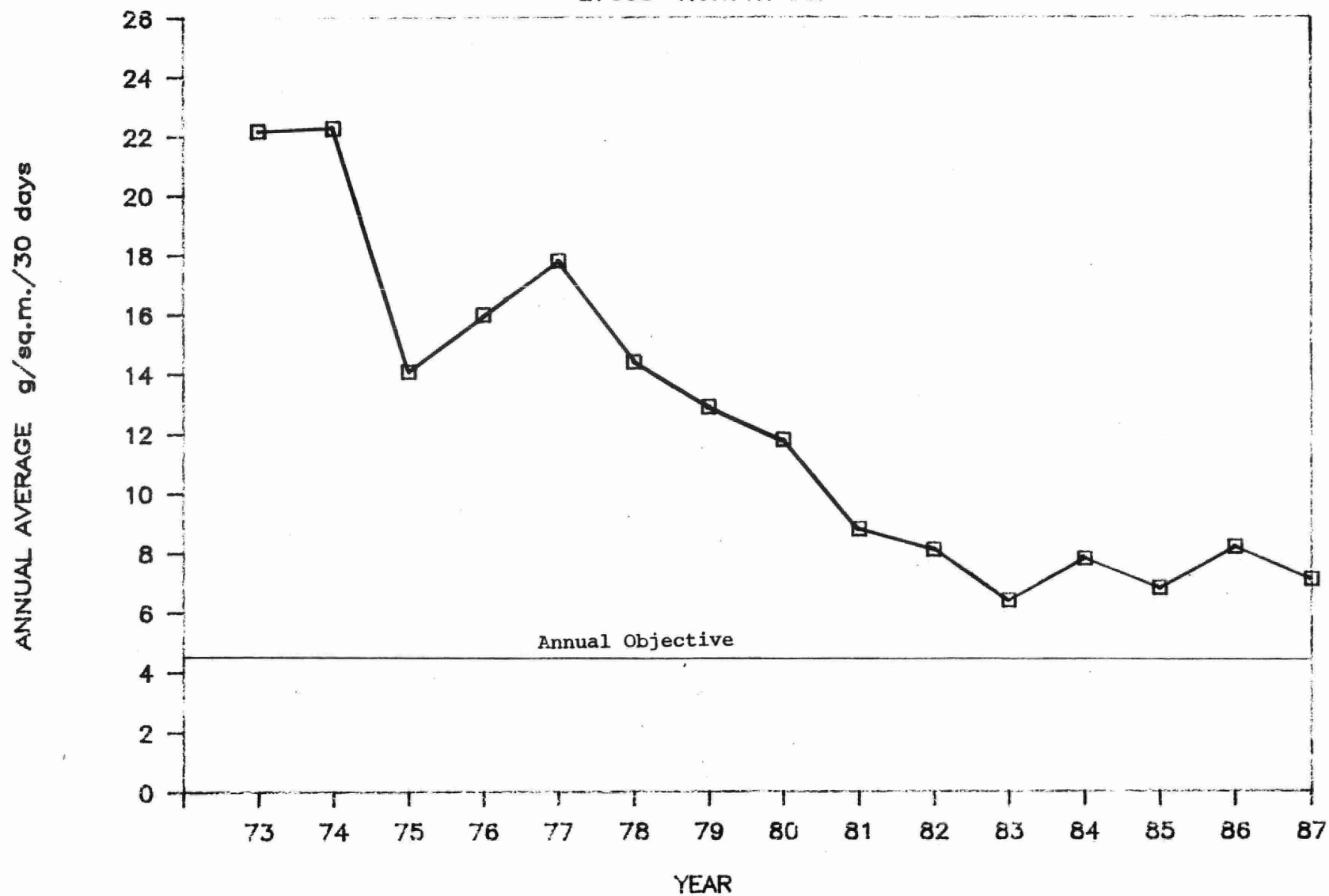


FIGURE 19  
DUSTFALL YEARLY TREND — CHIPPAWA  
27005 NORTON CO.



### Port Colborne

Hi-vol 27047 measuring suspended particulates 350 metres north-northwest of INCO (Figure 20) recorded generally low and acceptable concentrations, similar to previous years (Table 3).

One sample exceeded the daily objective on May 9, during a windstorm. The refinery's effect on TSP levels appears to be minor as no wind direction correlated well with the data.

The samples were analyzed for nickel, and there were no excessive concentrations above the objective ( $2 \text{ ug/m}^3$ ) although a few nickel readings were well above normal levels (Table 3). The nickel levels correlated strongly with winds from the refinery, indicating that INCO did have an effect on the measurements.

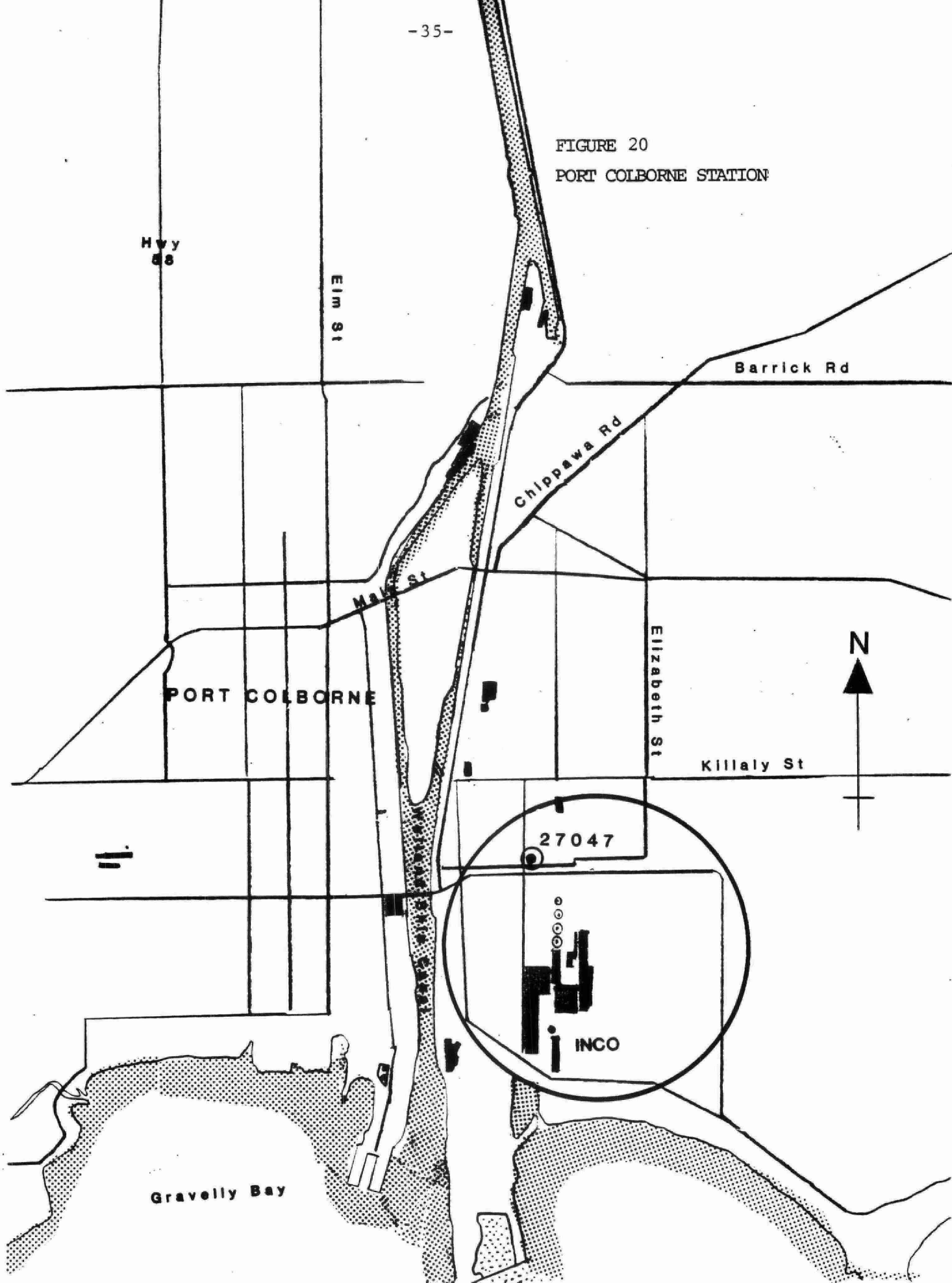
It would appear that INCO's effect on air quality was fairly small and localized. However, past Phytotoxicology Section surveys have demonstrated nickel contamination of vegetation in the area well above guidelines. No formal abatement program was scheduled for 1985-87 although the company has purchased neighbouring properties in order to provide a buffer zone. Process modifications were implemented in 1987 and reduced production probably further improved air quality.

The soil in the vicinity of the plant is nickel contaminated from past practices rather than current operations, and re-entrainment accounts for nickel deposition on vegetation.

### St. Catharines

In September, 1986, the St. Catharines API station 27037 at North and Geneva Streets was shut down. The building in which the station was housed was sold and slated for

FIGURE 20  
PORT COLBORNE STATION





**TABLE 3**  
SUMMARY STATISTICS - PORT COLBORNE  
PARTICULATES NEAR INCO

SUSPENDED PARTICULATES - micrograms per cubic metre				ONT.OBJECTIVES:		120 (24 hour)		60 (annual geo.mean)		
STATION	GEOMETRIC MEAN			1987 MAXIMUM 24 HR	NO.OF SAMPLES	NO.TIMES OVER OBJECTIVE(1987)			SOURCE MONITORED	
	1985	1986	1987			24 HR	1 YR			
27047 DAVIS/FRASER	49	52	45	126	50	1	0		INCO	
NICKEL IN SUSP.PARTIC. - micrograms per cubic metre				ONT.OBJECTIVE:		5.0 (24 hour)				
27047 DAVIS/FRASER	0.027	0.017	0.033	1.64	50	0			INCO	

demolition. The Ministry found a new site 1 km to the southeast on Argyle Crescent, off Eastchester Ave., just outside the downtown area (Figure 21). The station is numbered 27067 and began measuring sulphur dioxide, soiling index and the Air Pollution Index (API) in August, 1987. Although carbon monoxide, nitrogen dioxide and ozone analyzers also operated, technical problems prevented data gathering until 1988.

In the five months of operation, the API reached a maximum of 24 on October 17. Elevated pollutant levels were widespread on this day as indicated by higher APIs in Hamilton and Niagara Falls. Normally, however, the index was low, averaging only 6.

Sulphur dioxide and soiling index data for station 27067 are given in Table 4 and show low levels below all objectives except for one exceedence of the daily soiling index. This occurred during the October API maximum. Trend graphs for these two measurements (utilizing data from the old API station 27037) in Figures 22 and 23 show low stable levels. For sulphur dioxide in Figure 22 an increase in 1987 is apparent at the new station. This increase is explained by the fact that only the final five (and colder) months of the year were sampled. SO<sub>2</sub> levels are normally higher in fall and winter due to increased space heating.

Pollution roses for 27067 sulphur dioxide and soiling index are given in Figures 24 and 25 and show that highest concentrations occurred during south or southeast winds. This points both to certain industries south of the city and vehicle traffic on Eastchester Avenue.

Although data for carbon monoxide, nitrogen dioxide and ozone were not available, trend data from past years at 27037 are presented in Figures 26-28. Ozone and nitrogen dioxide have shown stable levels over the years while carbon monoxide has

FIGURE 21

ST. CATHARINES STATIONS

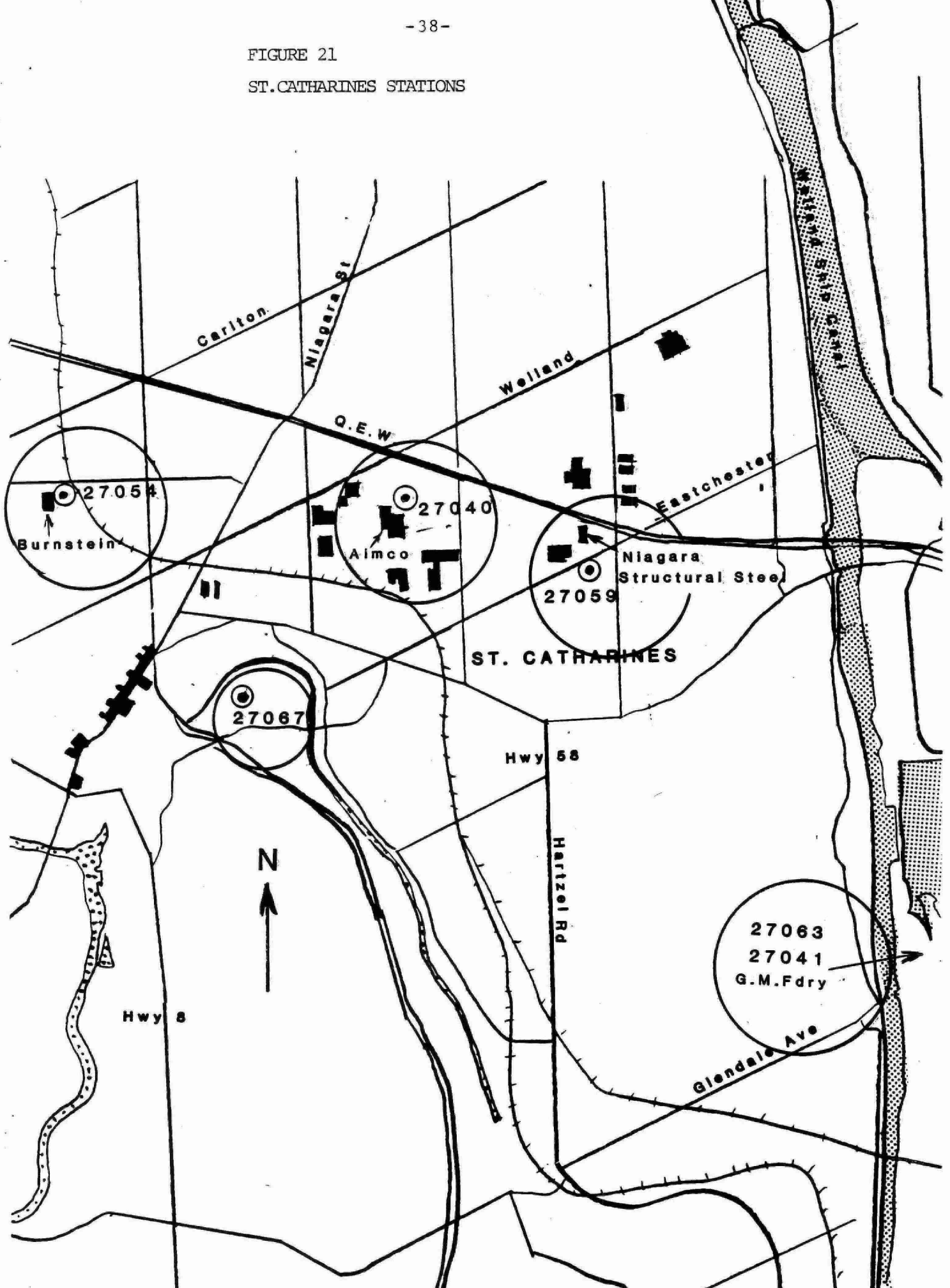


TABLE 4

## SUMMARY STATISTICS - ST. CATHARINES

## CONTINUOUS POLLUTANTS

\* 27067 - ARGYLE CRES. &amp; 27037 NORTH/GENEVA

\* 27037 was terminated in Sept. 1986 and resumed operations at 27067 in Aug. 1987  
ins insufficient data

POLLUTANT	ANNUAL AVERAGE			1987 MAXIMUM			OBJECTIVE			1 YR	NO. TIMES OVER OBJECTIVE(1987)			
	1985	1986	1987	1 HR	8 HR	24 HR	1 HR	8 HR	24 HR		1 HR	8 HR	24 HR	1 YR
SULPHUR DIOXIDE SO2(ppm)	0.006	0.005	0.010	0.14		0.03	0.25		0.10	0.02	0		0	0
SOILING INDEX COH(COH'S)	0.26	0.24	0.27			1.3			1.0	0.5			1	0
CARBON MONOXIDE CO(ppm)	0.2	0.2	ins	ins	ins		30	13						
NITROGEN DIOXIDE NO2(ppm)	0.017	0.019	ins	ins		ins	0.20		0.10					
OZONE O3(ppb)	17.9	21.9	ins	ins			80							

OBJECTIVES: 120 (24 hour)  
60 (annual geo mean)

## SUSPENDED PARTICULATES - micrograms per cubic metre

STATION +	GEOMETRIC MEAN			1987 MAXIMUM 24 HR	NO. OF SAMPLES	NO. TIMES OVER OBJECTIVE (1987)	
	1985	1986	1987			24 HR	1 YR
27037 NORTH/GENEVA & 27008 KING ST.	50	60	47	203	39	1	0

+ 27037 was terminated in Sept 1986 and resumed operations at 27008 in March 1987

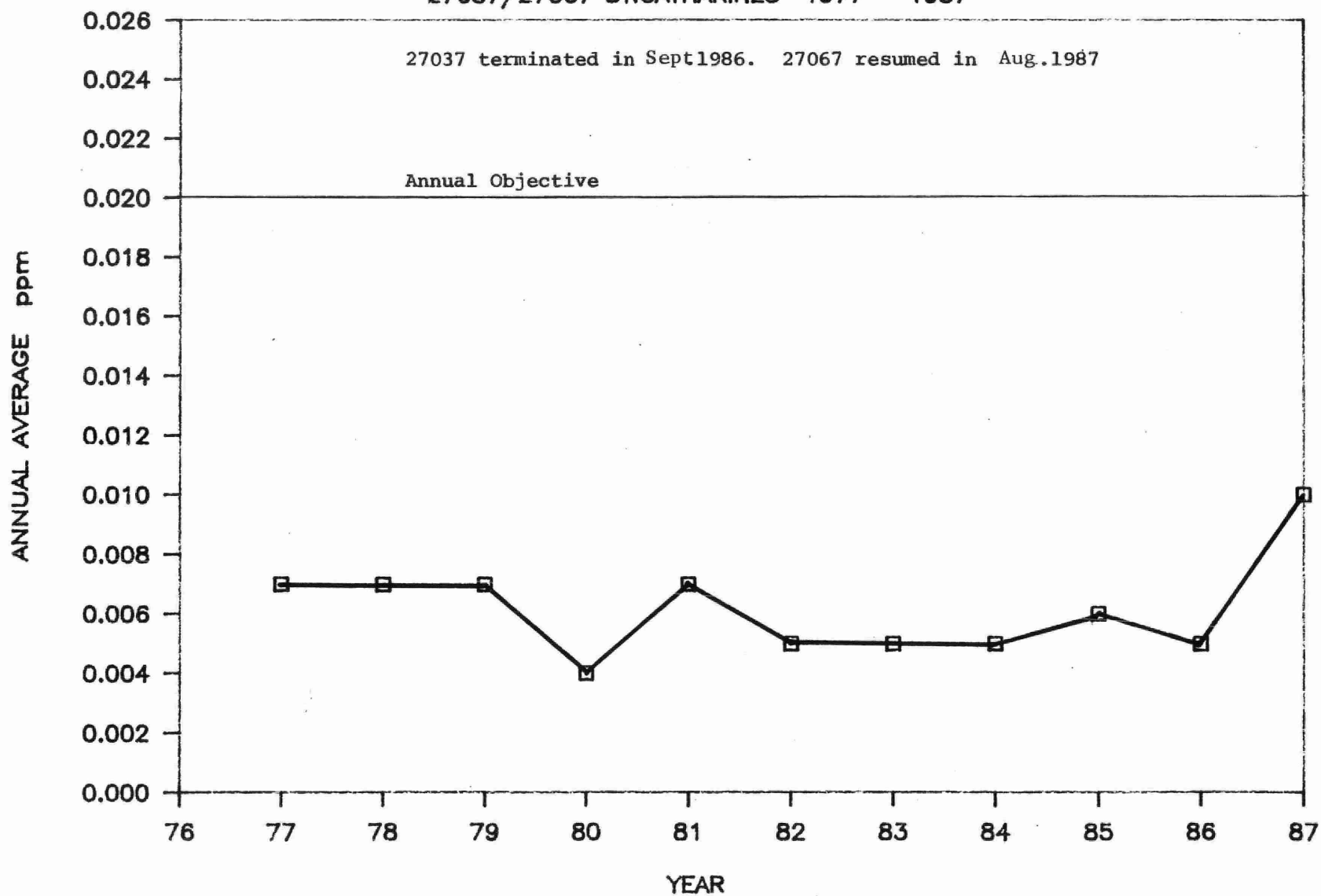
## DUSTFALL - grams/square metre/30 days

ONT. OBJECTIVE : 7.0 (1 MONTH)  
4.5 (ANNUAL AVERAGE)

STATION	ANNUAL AVERAGE			1987 MAXIMUM 1 MONTH	NO. MONTHS OVER OBJECTIVE			SOURCE MONITORED
	1985	1986	1987		1985	1986	1987	
27040 - PLYMOUTH AV ST. CATHARINES	14.5	13.7	11.0	30.7	11	9	10	AIMCO FDRY
27041 - GLENDALE AV ST. CATHARINES	8.2	8.1	7.6	13.8	9	7	6	GM FDRY
27063 - GM FOUNDRY ST. CATHARINES	-	-	7.5	14.8			6	GM FDRY
27054 - CATHERINE ST ST. CATHARINES	6.4	8.8	4.4	11.9	4	4	1	BURNSTEIN CASTINGS
27059 - EASTCHESTER ST. CATHARINES	-	6.6	4.0	5.7	-	3	0	NIAGARA STRUCT STEEL

# FIGURE 22 SULPHUR DIOXIDE YEARLY TREND

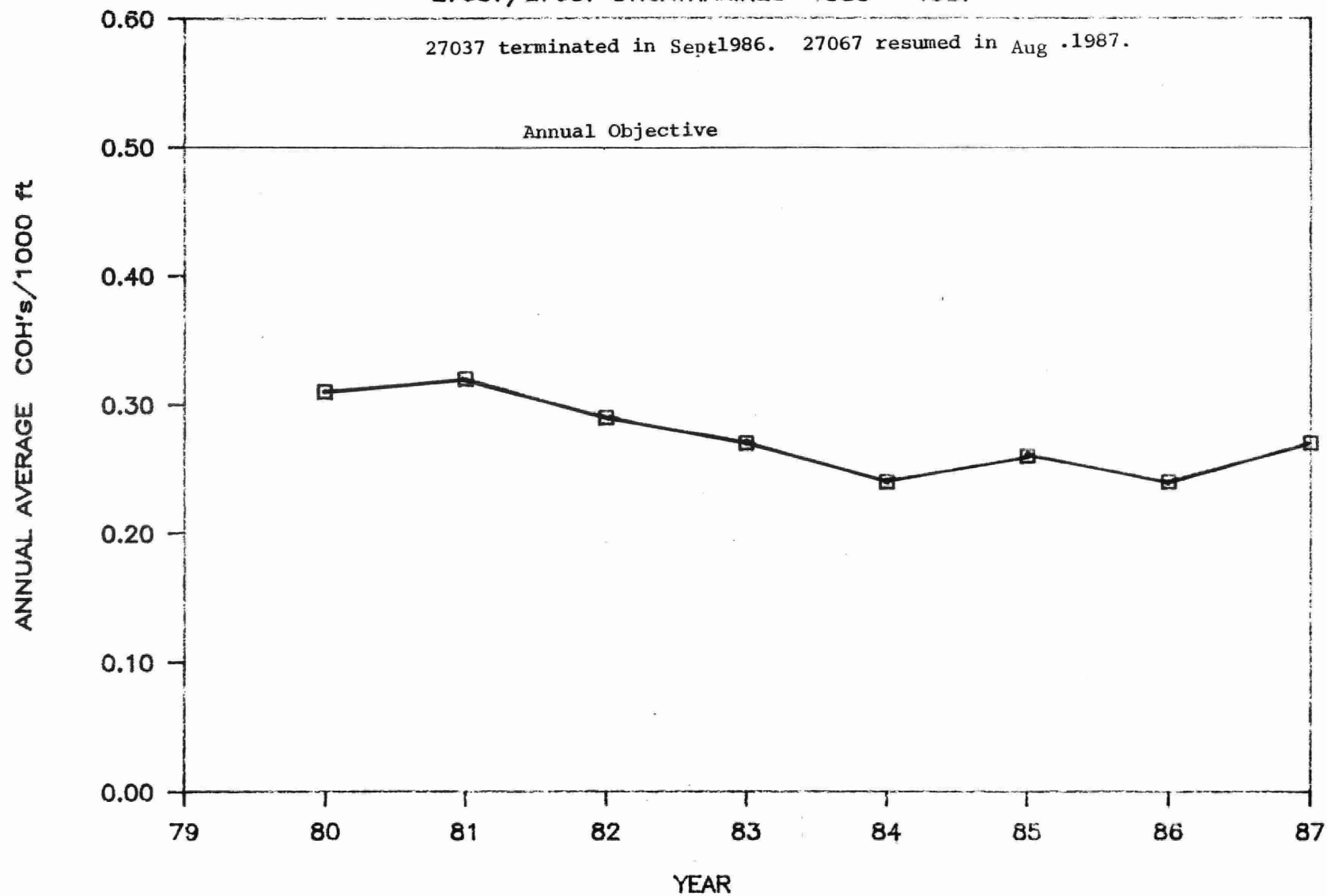
27037/27067 ST.CATHARINES 1977 - 1987

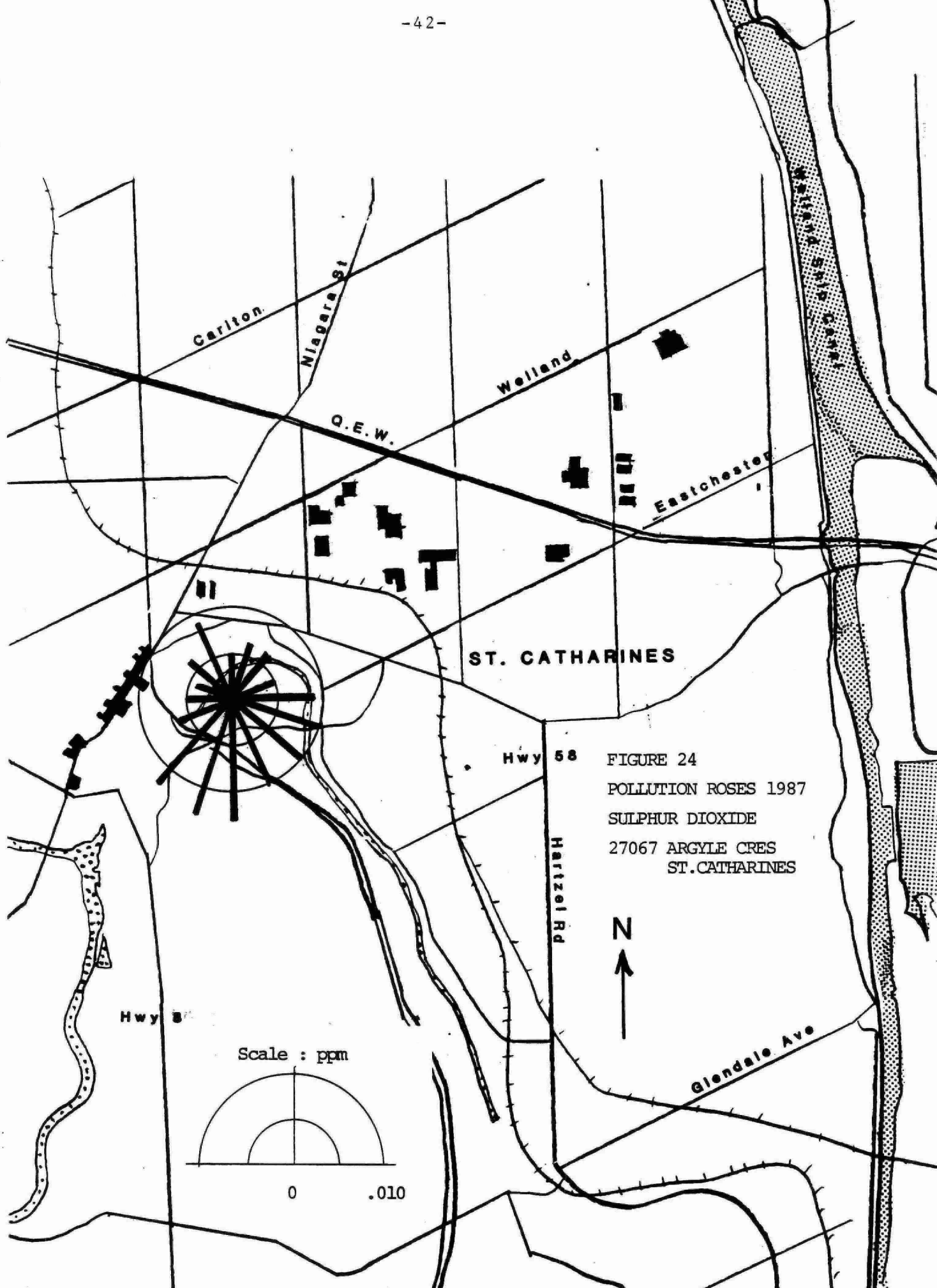


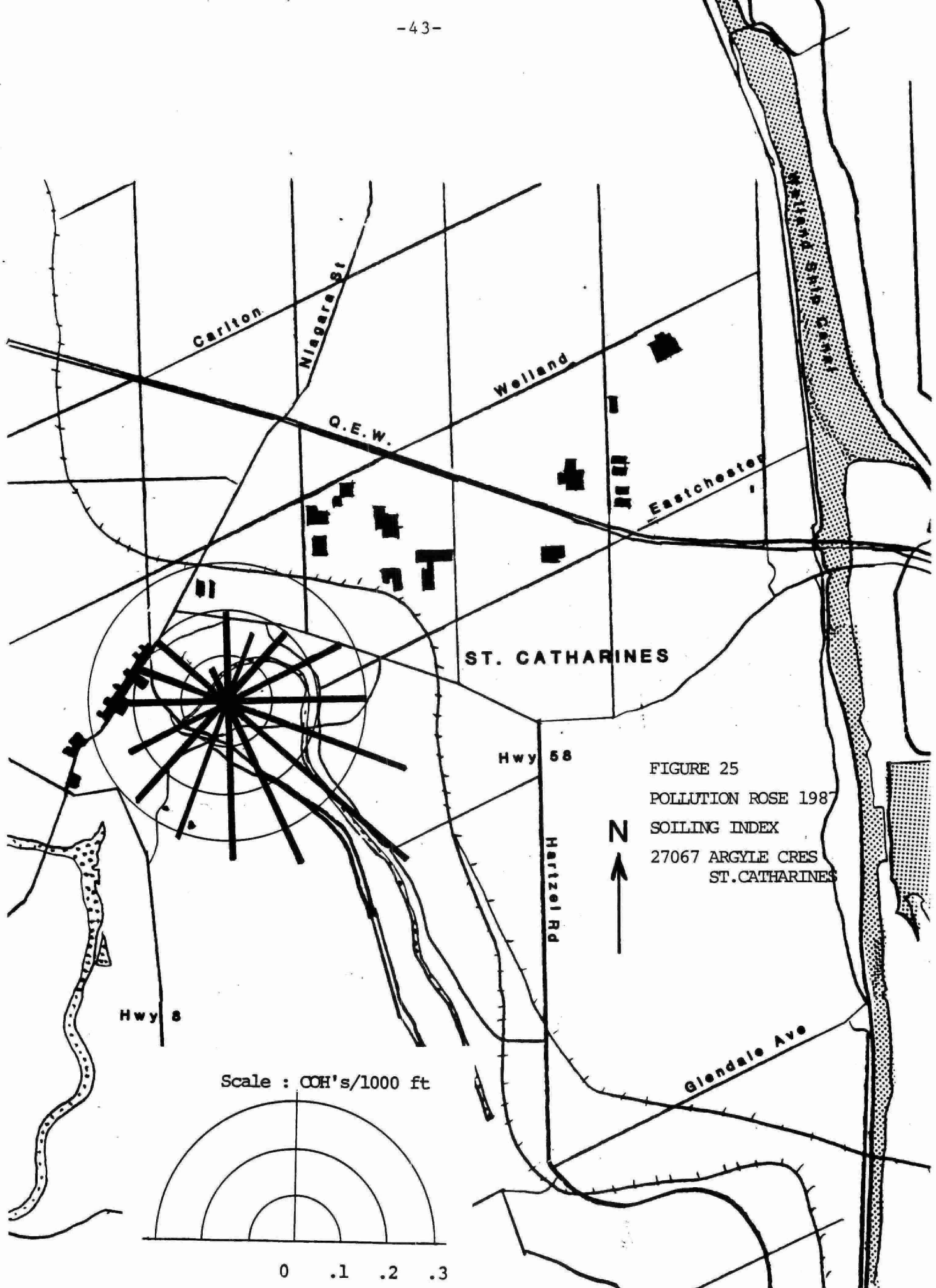
# FIGURE 23 SOILING INDEX YEARLY TREND

27037/27067 ST.CATHARINES 1980 - 1987

27037 terminated in Sept 1986. 27067 resumed in Aug 1987.



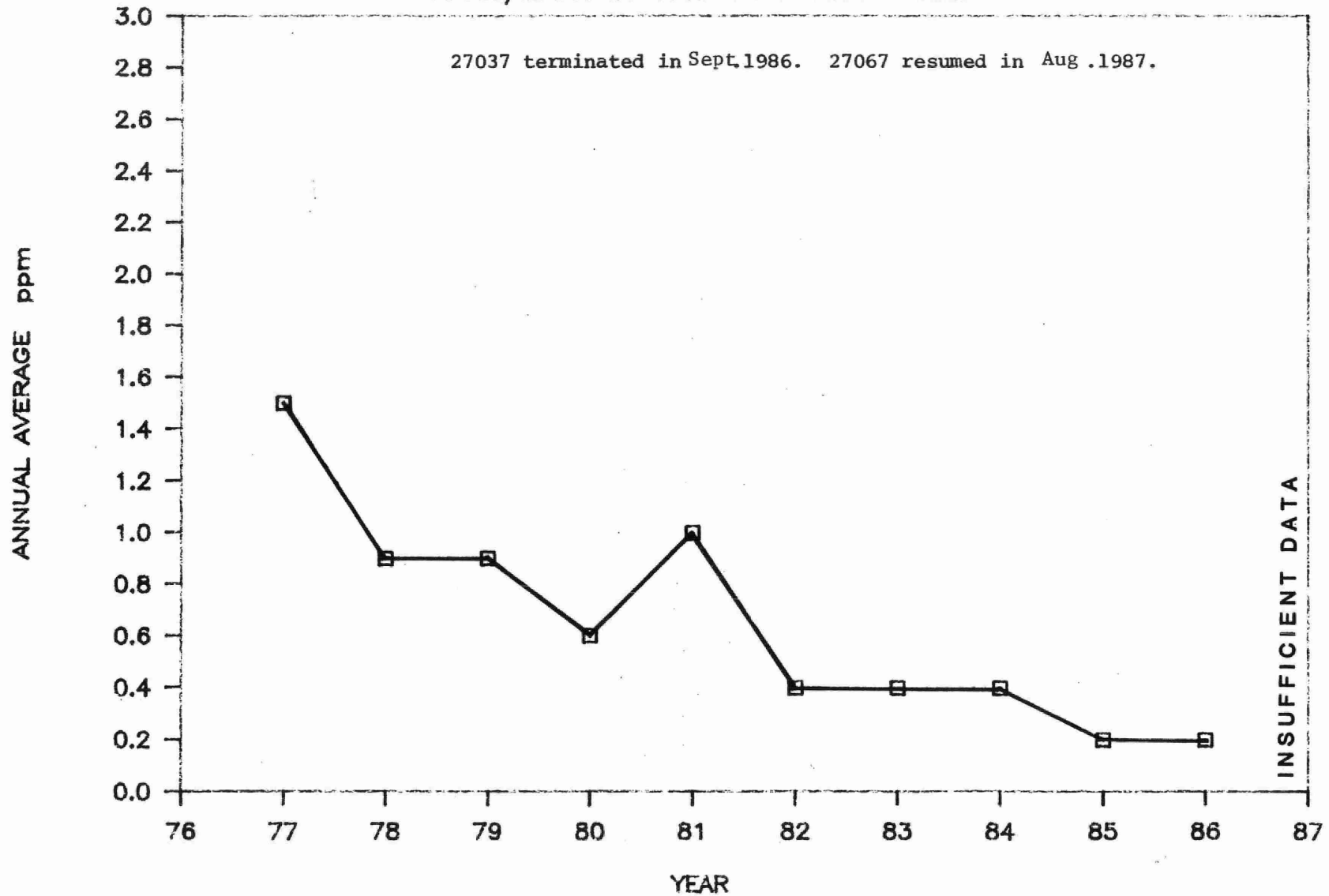






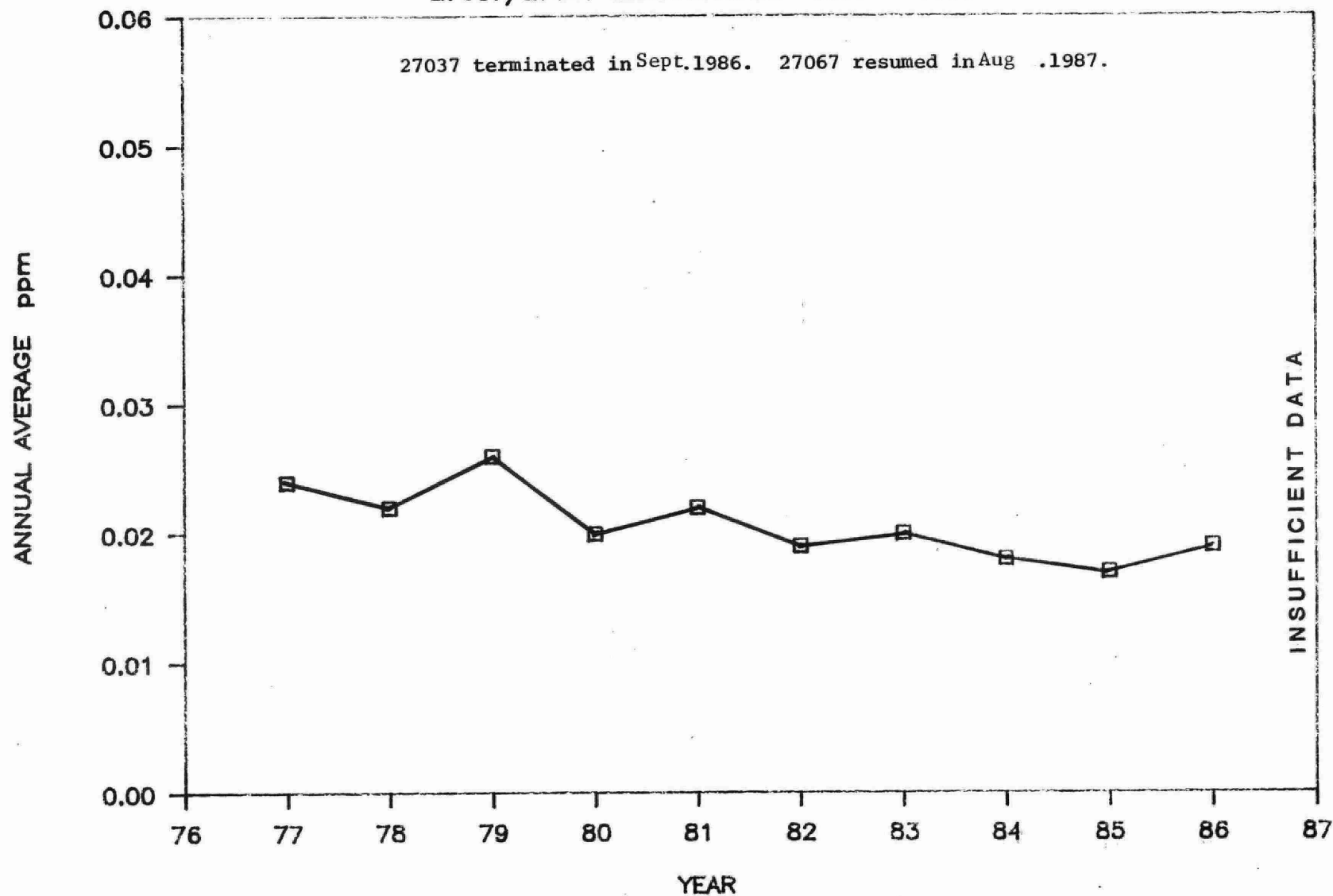
# FIGURE 26 CARBON MONOXIDE YEARLY TREND

27037/27067 ST.CATHARINES 1977 - 1987



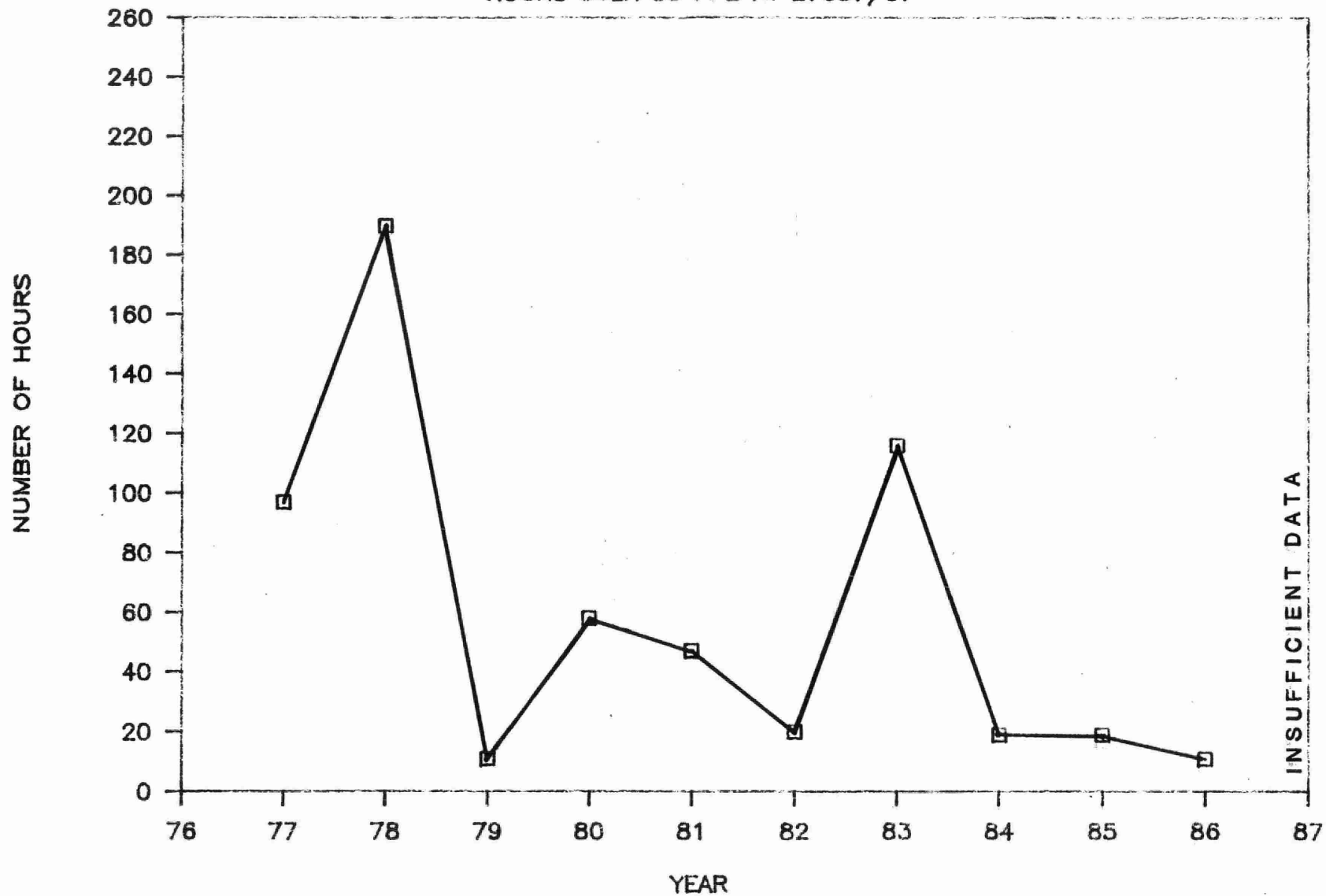
# FIGURE 27 NITROGEN DIOXIDE YEARLY TREND

27037/27067 ST.CATHARINES 1977 - 1987



# FIGURE 28 OZONE EXCEEDENCE TREND — ST.CATHARINES

HOURS OVER 80 PPB AT 27037/67



gradually declined, due mostly to improvements in vehicle emission control systems.

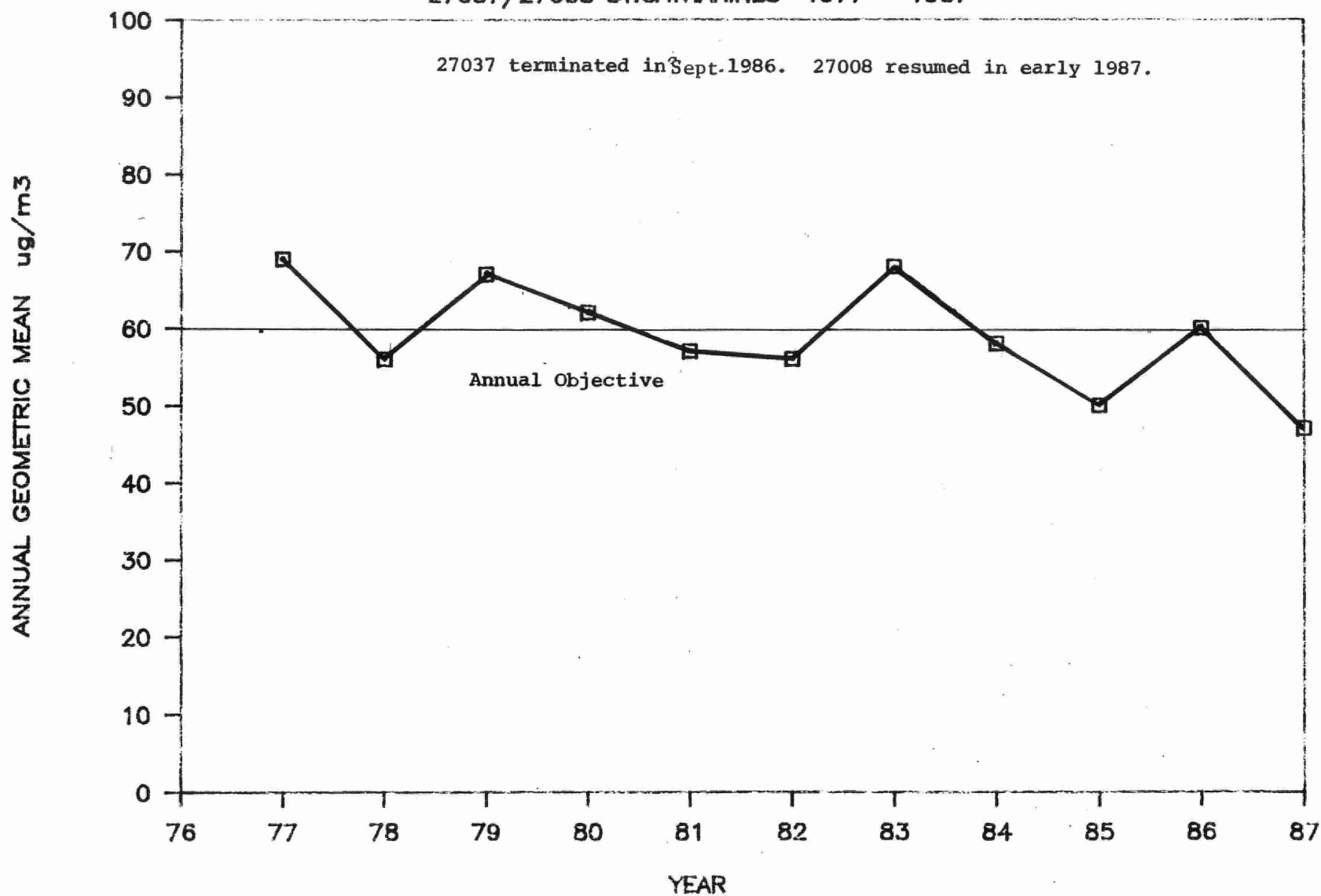
The hi-vol at the St. Catharines API station was replaced by downtown Station 27008 in 1987 and recorded acceptable suspended particulate concentrations (Table 4), with only one exceedence of the daily objective on May 9 due to a windstorm. Annual trends at this station given in Figure 29 have been relatively stable over the years, fluctuating marginally above and below the annual objective although a gradual improvement seems evident in the graph.

Dustfall near the Aimco Foundry at the Plymouth Ave., station 27040 (Table 4) remained very high as shown in Figure 30, and continued to show elevated concentrations above objectives during 10 months. Concentrations have been essentially unchanged from the 1970's. Some extremely high readings occurred up to June, but from July to the end of the year, levels reduced considerably although still exceeding the objectives. The improvement was related to improved maintenance of the control system, a program to reduce road dust on plant roads and some operations changes. In early 1989, the Ministry plans to complete an air emissions survey of the company.

Dustfall near the General Motors Foundry at Station 27041, Glendale and QEW, (Figure 21, Figure 30 and Table 4) was also high with 6 months exceeding the monthly objective. However, a nearby quarry and related trucking operations were potential contributors to the readings, and microscopic analyses of the samples did show that some samples were composed partly of non-foundry materials, namely carbonates. To ascertain the extent of the quarry's effect on 27041, a second jar (27063) was located directly on G.M. property, away from the quarry road. Data at this new location showed concentrations similar on average to 27041 and also yielded 6 exceedences of the monthly objective. Both stations showed

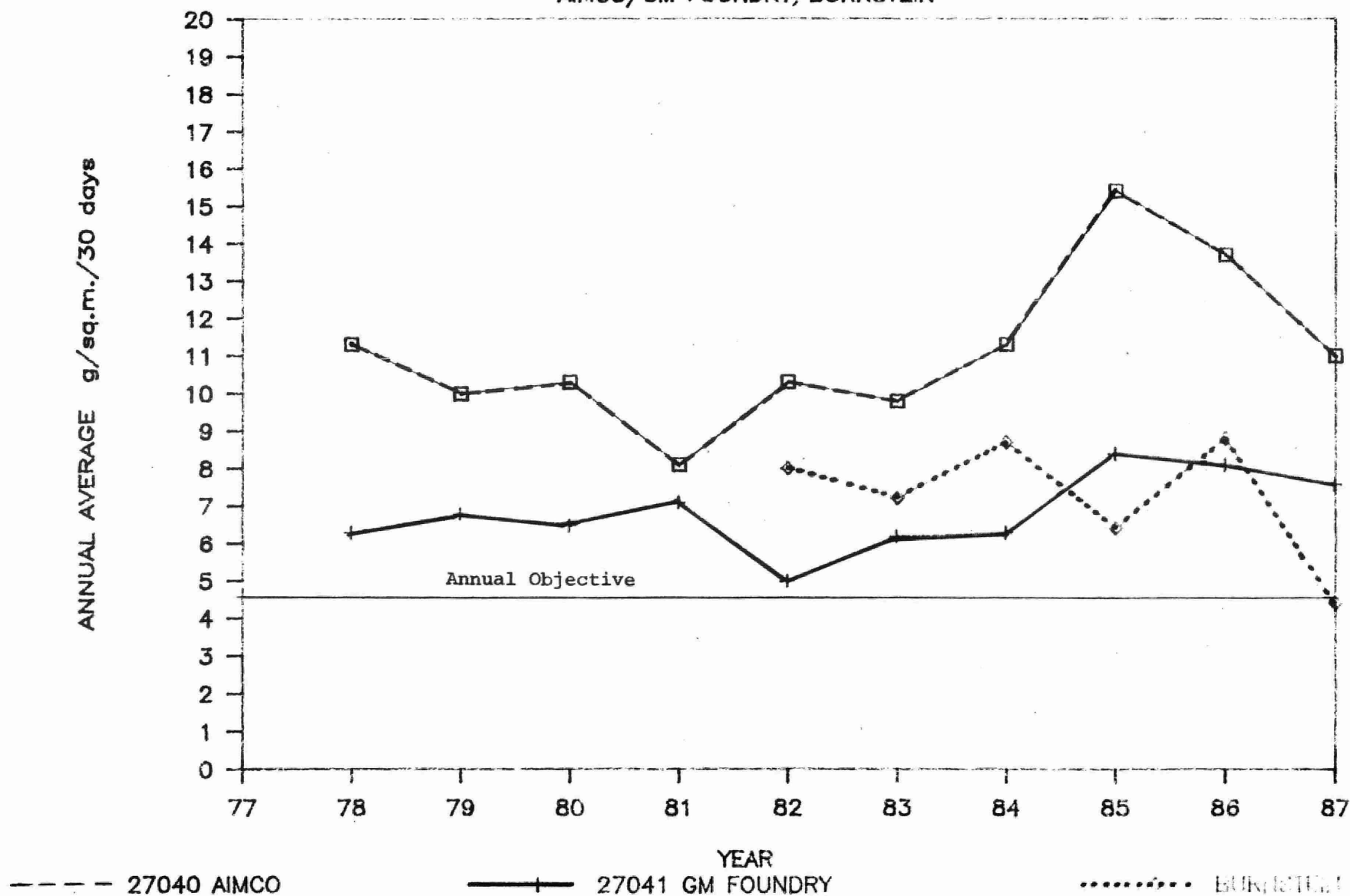
# FIGURE 29 SUSPENDED PARTICULATES YEARLY TREND

27037/27008 ST.CATHARINES 1977 - 1987



**FIGURE 30**  
**DUSTFALL YEARLY TREND — ST.CATHARINES**

AIMCO/GM FOUNDRY/BURNSTEIN



an alternating effect from the quarry and from the foundry. Microscopic analysis showed some samples composed mostly of carbonate (quarry) while others were composed mostly of foundry materials such as carbon, silica and iron oxide.

The major sources of foundry particulate emissions are the furnace operations. G.M. replaced one furnace control system in September 1988 and the remaining furnace control system will be replaced in 1989.

Dustfall near Burnstein Castings at Station 27054, Catherine and Russel (Figure 21), showed only one excessive loading (Table 4) and a distinct improvement from previous years, as shown in Figure 30. A survey of the company was carried out by Abatement staff and a number of problems were identified. A Control Order was served later in 1988 to address odour and particulate emission problems.

Dustfall was also measured by station 27059 on Eastchester Avenue, near Niagara Structural Steel (now known as Canadian Erectors) -a steel finishing operation which included sandblasting. Sampling actually began in 1986, and in 1987 an improvement was observed with all objectives being met (3 samples had exceeded the monthly objective in 1986). The sampling was terminated in 1988. An Environmental Appeals Board decision requires the company to comply with a Control Order on their sandblasting operation and implement controls by early 1989.

#### Thorold

Sulphur dioxide measured at Station 27042, Niagara Falls Rd. and Ontario St., across from Ontario Paper Limited (Figure 31), showed an acceptable yearly average in 1987. A total of 9 hourly readings exceeded the hourly objective (none after May), and the daily objective was not exceeded (Table 5). The major source of SO<sub>2</sub> was the chemical recovery plant but this plant was shut down in 1988. The trend graph

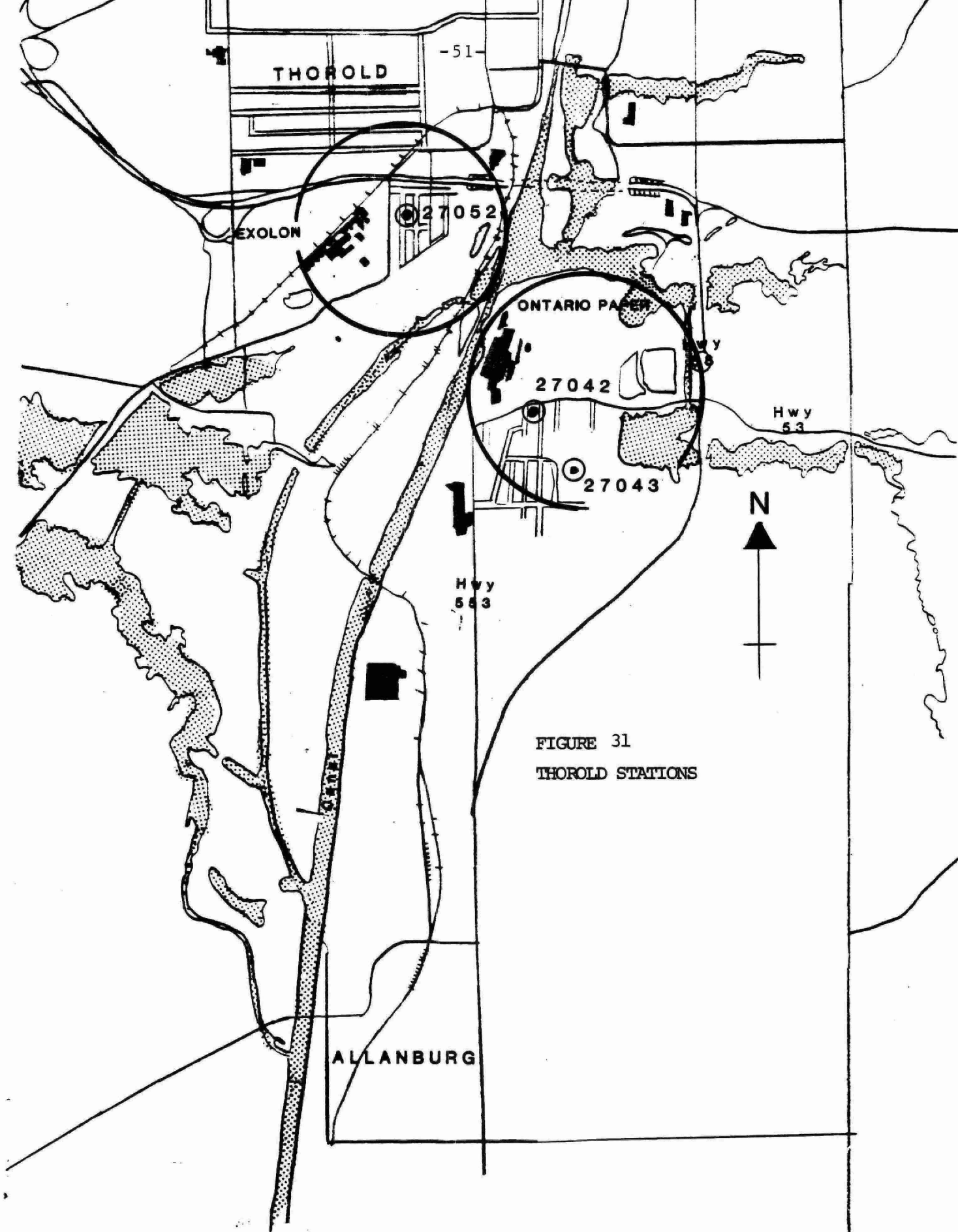


FIGURE 31  
THOROLD STATIONS



TABLE 5

## SUMMARY STATISTICS - THOROLD

CONTINUOUS POLLUTANTS NEAR EXOLON LTD.

27052 - QUEEN ST.

POLLUTANT	ANNUAL AVERAGE			1987 MAXIMUM		OBJECTIVE		1 YR	NO. TIMES OVER OBJECTIVE(1987)		
	1985	1986	1987	1 HR	24 HR	1 HR	24 HR		1 HR	24 HR	1 YR
SULPHUR DIOXIDE SO <sub>2</sub> (ppm)	0.017	0.012	0.008	0.30	0.10	0.25	0.10	0.02	5	0	0
SOILING INDEX COH(COH'S)	0.29	0.30	0.31		0.9		1.0	0.5		0	0
TOTAL REDUCED SULPHUR (TRS) (ppb)	2.9	1.9	3.0	150		20(H <sub>2</sub> S)			357 583 hours	10ppb	

## SUMMARY STATISTICS - THOROLD

CONTINUOUS POLLUTANTS NEAR ONTARIO PAPER LTD.

27042 - NIAG FALLS RD./ONTARIO ST.

POLLUTANT	ANNUAL AVERAGE			1987 MAXIMUM		OBJECTIVE		1 YR	NO. TIMES OVER OBJECTIVE(1987)		
	1985	1986	1987	1 HR	24 HR	1 HR	24 HR		1 HR	24 HR	1 YR
SULPHUR DIOXIDE SO <sub>2</sub> (ppm)	0.001	0.005	0.005	0.70	0.09	0.25	0.10	0.02	9	0	0

SUSPENDED PARTICULATES - micrograms per cubic metre

ONT.OBJECTIVES: 120 (24 hour)  
60 (annual geo.mean)

STATION	GEOMETRIC MEAN			1987 MAXIMUM 24 HR	NO. OF SAMPLES	NO. TIMES OVER OBJECTIVE(1987)		SOURCE MONITORED
	1985	1986	1987			24 HR	1 YR	
27052 QUEEN ST	106	144	167	483	51	36	1	EXOLON

DUSTFALL - grams/square metre/30 days

ONT.OBJECTIVE : 7.0(1 MONTH)  
4.5(ANNUAL AVERAGE)

STATION	ANNUAL AVERAGE			1987 MAXIMUM 1 MONTH	NO. MONTHS OVER OBJECTIVE			SOURCE MONITORED
	1985	1986	1987		1985	1986	1987	
27042 - NIAG/ONT THOROLD	7.7	7.3	6.9	11.0	7	7	6	ONT PAPER
27043 - MCADAM PARK	3.9	3.2	2.4	6.7	1	0	0	BACKGROUND

in Figure 32 displays the marked reduction in the number of exceedences of the hourly objective since 1983. The initial improvement was due to the installation of a scrubber on the company's acid plant in 1981. Now that the chemical recovery plant has shut down, all SO<sub>2</sub> objectives should be met in future.

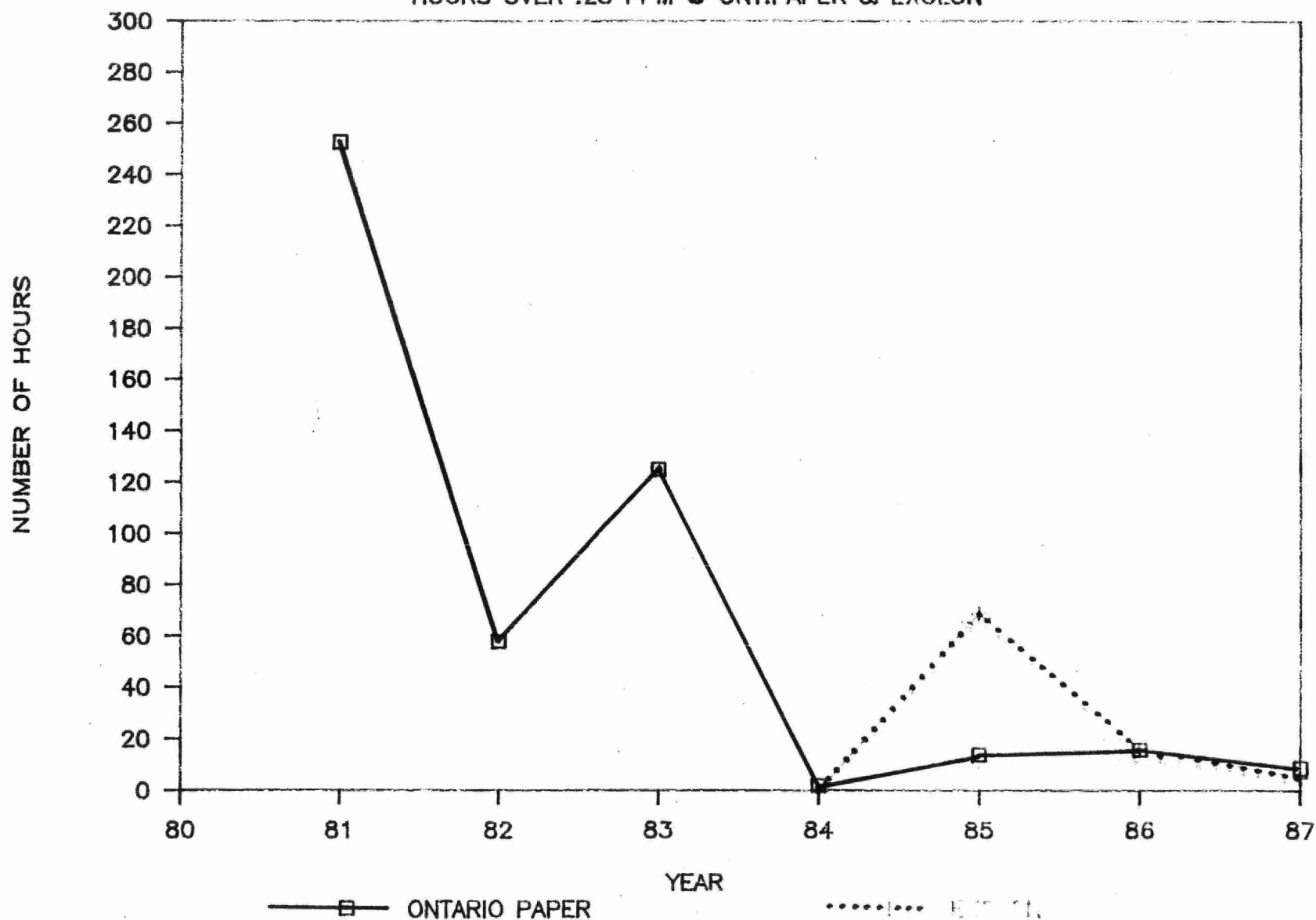
Dustfall near the paper mill is given in Table 5. It shows that the yearly average at station 27042 was three times as high as at the background station 27043 at McAdam Park. Sulphate contents were also 3 times as high. Six samples exceeded the monthly objective at 27042. The trend graph in Figure 34 shows that improvements have taken place during the 1980s. The major source of particulate was the chemical recovery plant, specifically the vanillin plant. Now that the chemical recovery plant has been shut down, dustfall levels should improve.

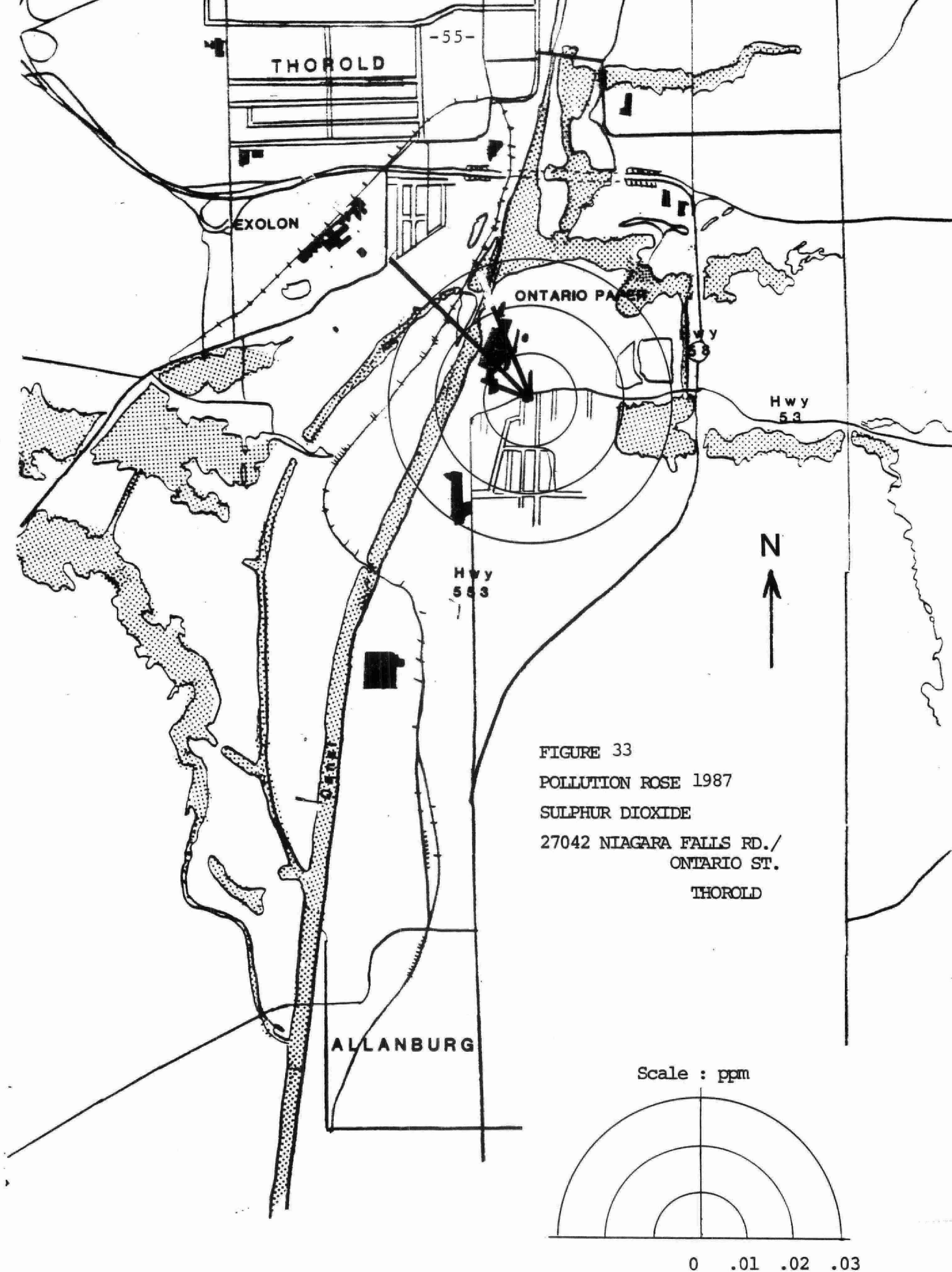
Station 27052 lies 100 metres northeast of Exolon Ltd. on Queen Street (Figure 31) and consists of a hi-vol, soiling index tape sampler and SO<sub>2</sub> and TRS analyzers. Data are summarized in Table 5. Sulphur dioxide levels improved further in 1987, recording only 5 exceedences of the hourly objective (compared to 69 in 1985). However, TRS levels which were already extremely high, increased in 1987. There were 357 hours above the hourly objective for hydrogen sulphide (20 ppb) and 583 hours above 10 ppb - an approximate odour threshold for H<sub>2</sub>S. There were 384 such hours in 1986. The deterioration illustrated in Figure 35 is probably related to increased production.

The major sources of these emissions are the silicon carbide furnaces. The company was on a voluntary program for control of these furnaces by 1989. However, interim items of the program have not been complied with and have resulted in the program being rescinded. The Ministry will conduct an

**FIGURE 32**  
**SO<sub>2</sub> EXCEEDENCE TREND — THOROLD**

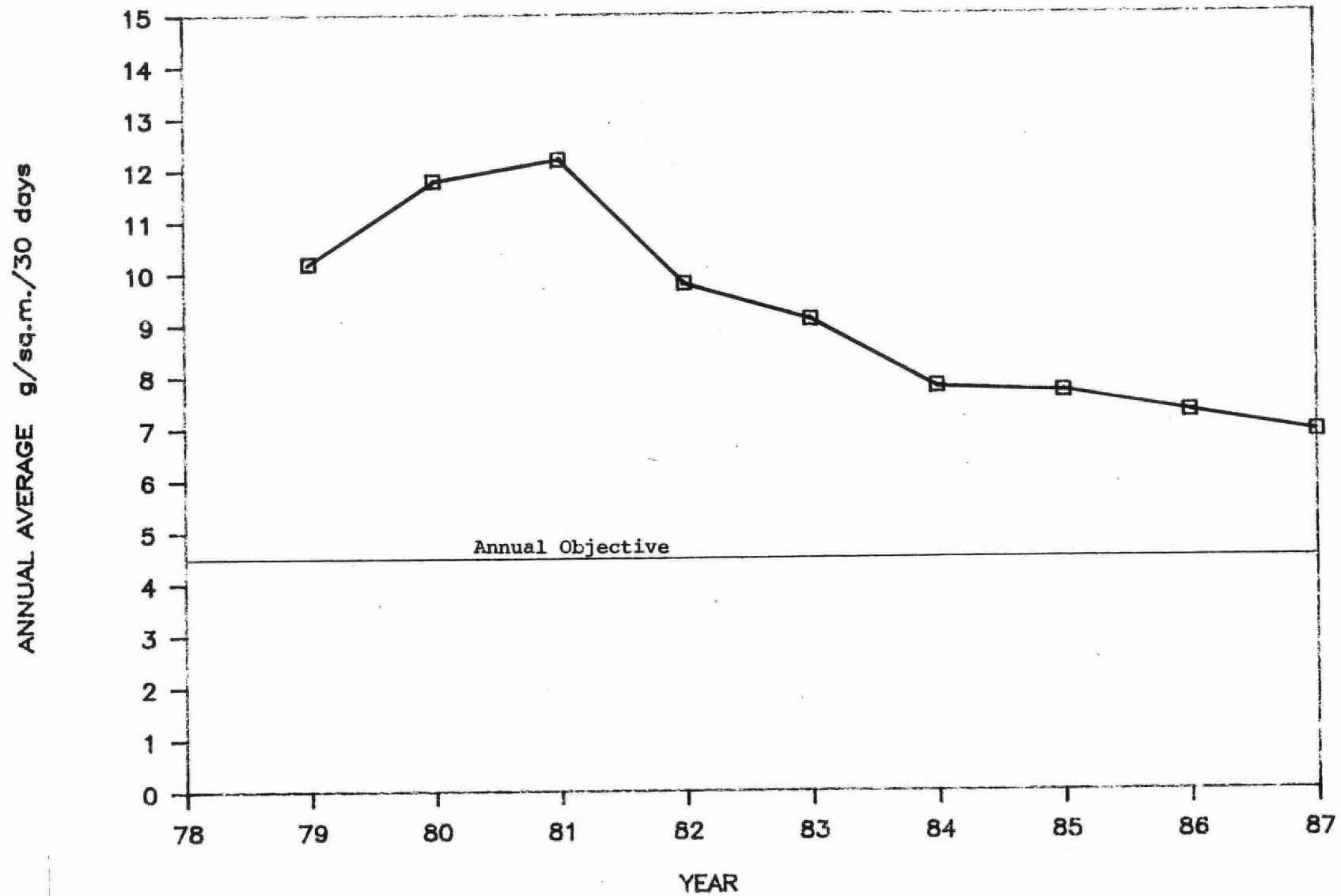
HOURS OVER .25 PPM @ ONT.PAPER & EXOLON



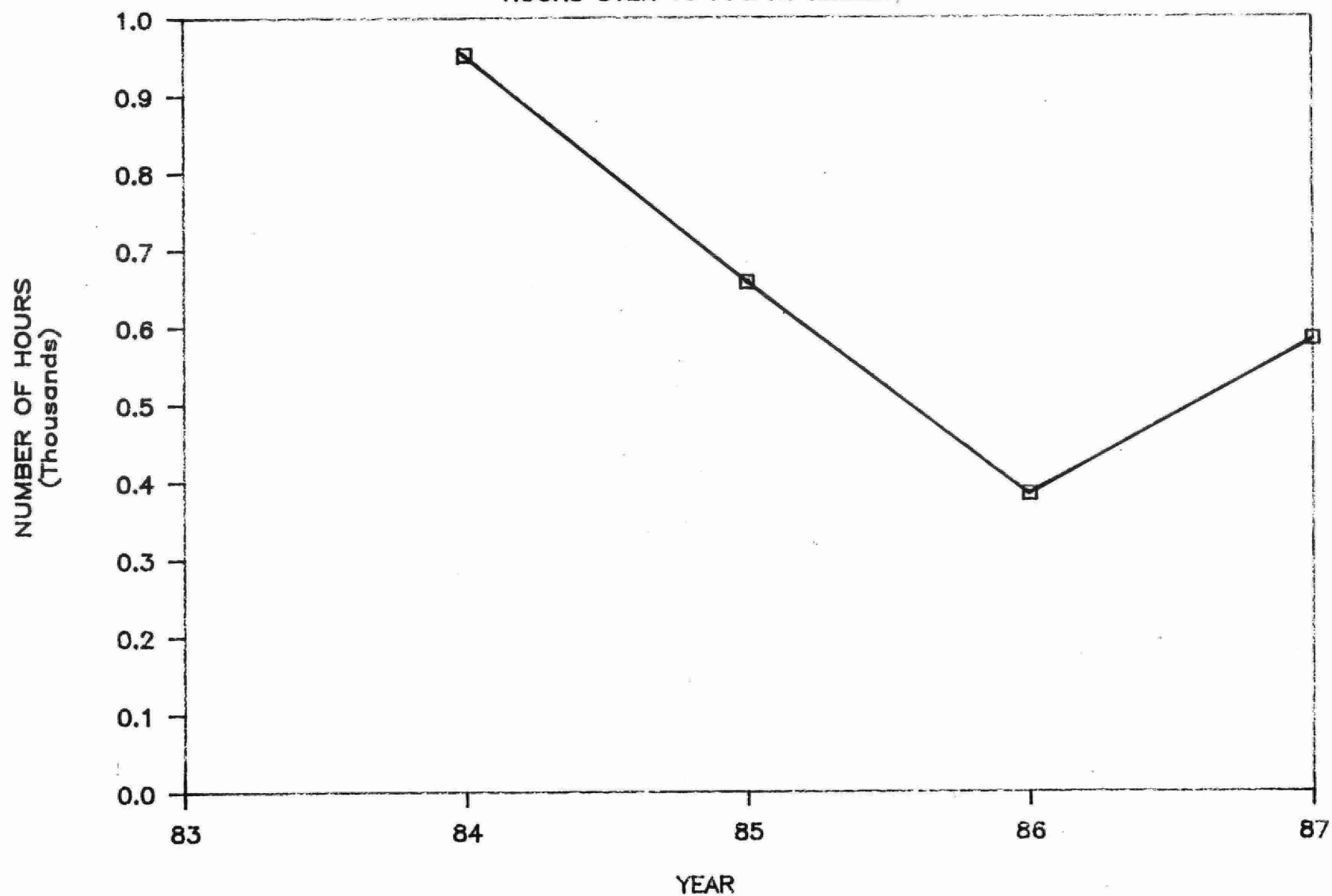


**FIGURE 34**  
**DUSTFALL YEARLY TREND — THOROLD**

27042 ONTARIO PAPER



**FIGURE 35**  
**TRS EXCEEDENCE TREND — THOROLD**  
**HOURS OVER 10 PPB AT EXOLON**



emission survey in early 1989, the intent of which is to serve a Control Order in 1989.

The pollution roses in Figures 36 and 37 indicate the influence of Exolon as both SO<sub>2</sub> and TRS peaked sharply under west and west-southwest winds.

Suspended particulates at station 27052 (Table 5) showed extremely high levels with a geometric mean of 167 ug/m<sup>3</sup> (up sharply from 144 in 1986 and 106 in 1985), and 36 out of 51 samples exceeded the daily objective. The silicon carbide furnaces are also the major source of particulate emissions. The deterioration in particulate levels was due to increased production.

The soiling index tape sampler at 27052 recorded low levels of fine particulate with no exceedences of the daily objective (Table 5). The soiling index pollution rose in Figure 38 shows little impact from the plant. Particulate emissions from Exolon would seem to consist mostly of heavy material not measured by the tape sampler.

#### Welland

Particulates near Union Carbide were measured by one high volume sampler and three dustfall jars in 1987 (Figure 39).

Suspended particulate concentrations at station 27045, Alberta and Devon, (Table 6) remained stable in 1987. The yearly geometric mean was well below the objective and the daily objective was exceeded once on May 9 during a windstorm. The trend graph in Figure 40 shows a stable trend since 1981, below the yearly objective.

Occasionally elevated carbon concentrations (Table 6) were measured, and these data correlated weakly with southwest wind frequency, indicating Union Carbide's localized

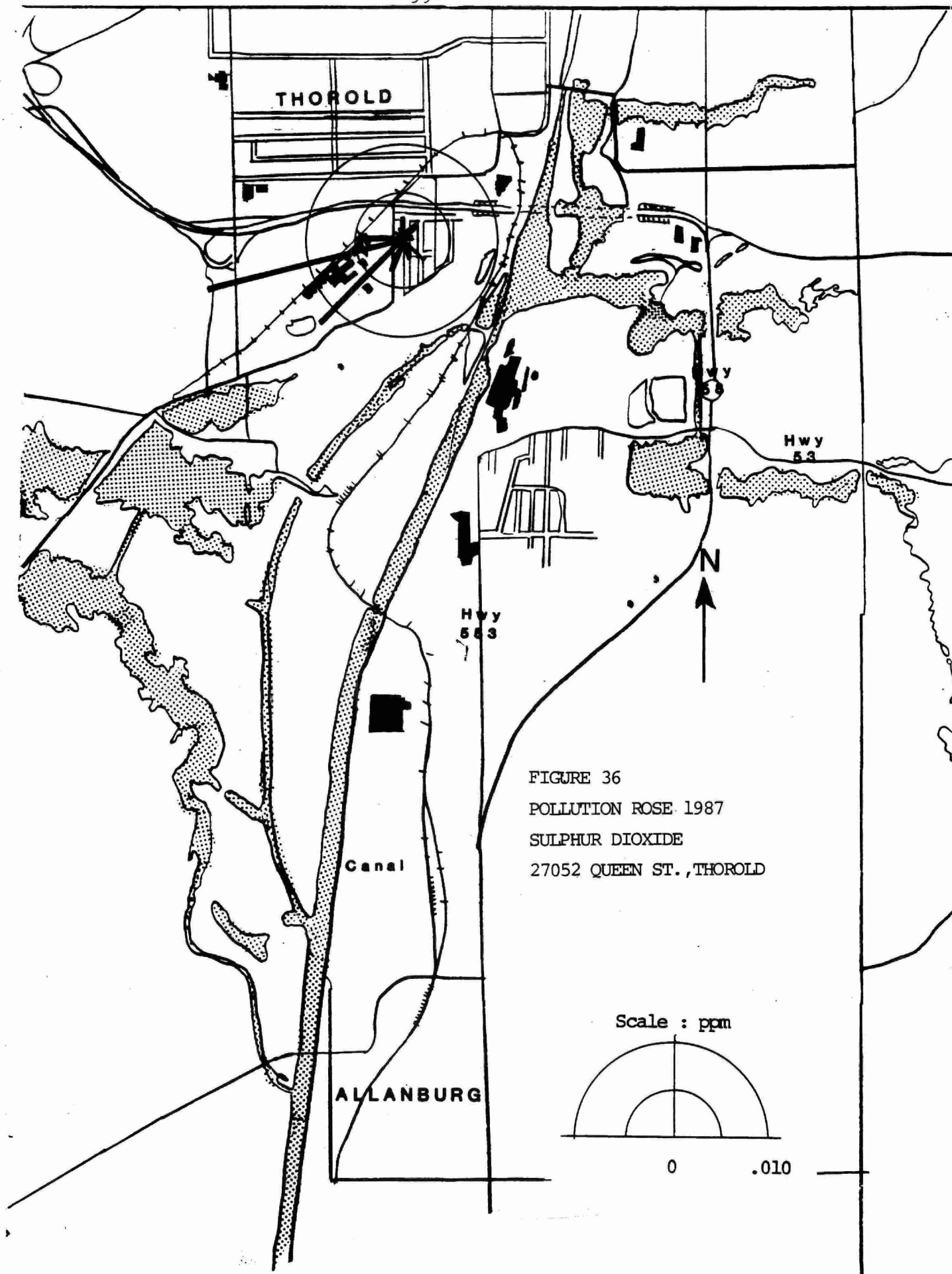
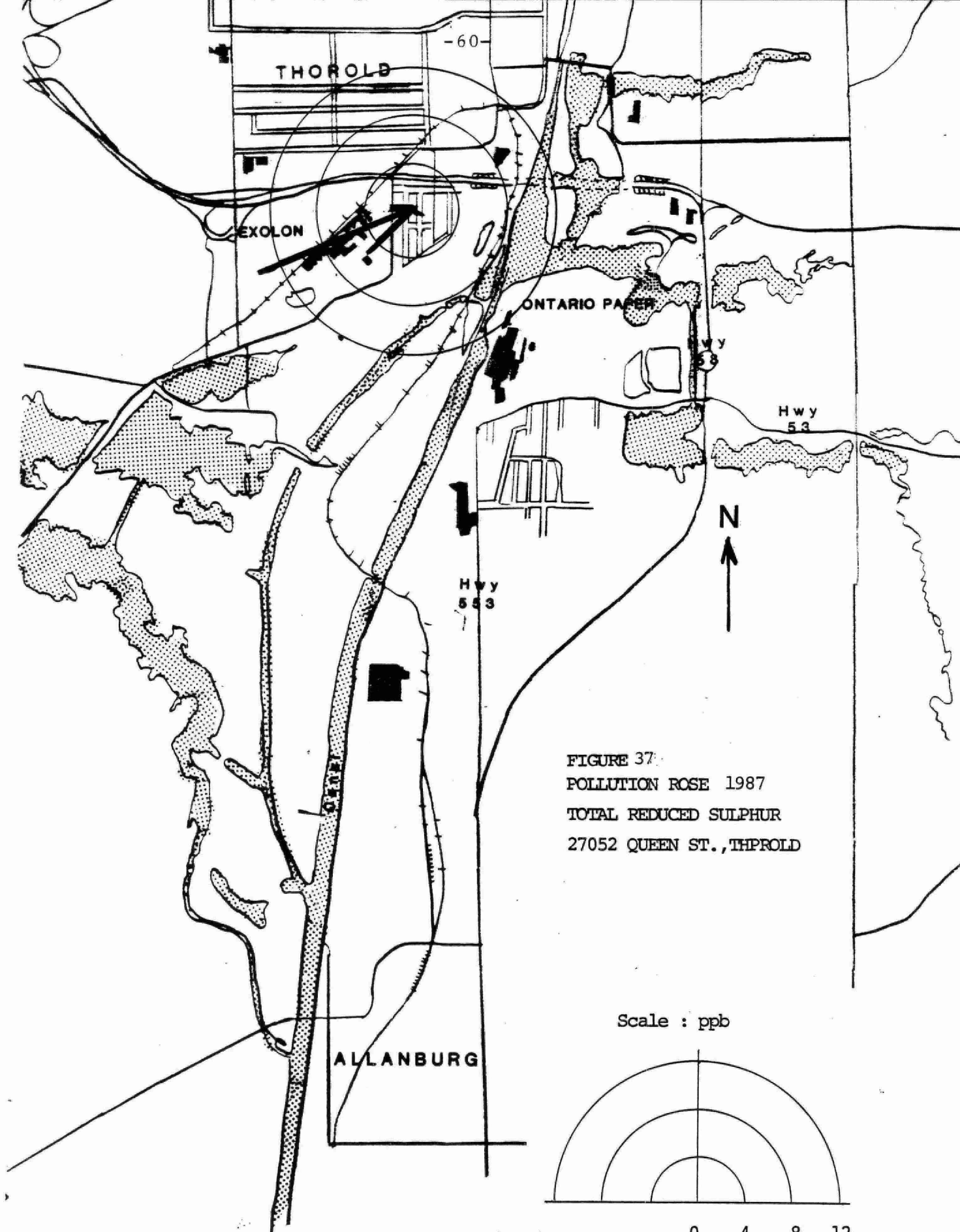


FIGURE 36  
POLLUTION ROSE 1987  
SULPHUR DIOXIDE  
27052 QUEEN ST., THOROLD





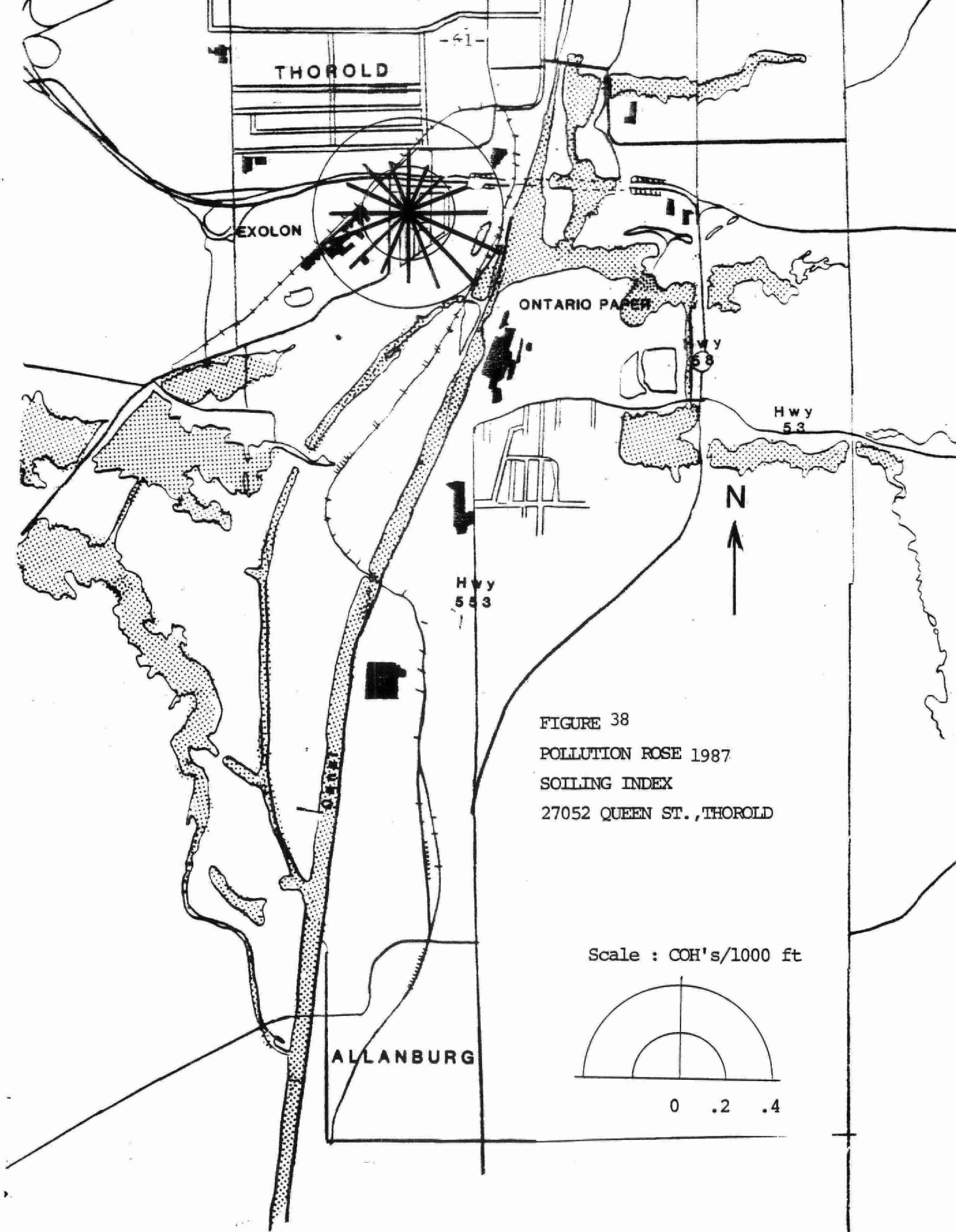


FIGURE 38  
POLLUTION ROSE 1987  
SOILING INDEX  
27052 QUEEN ST., THOROLD

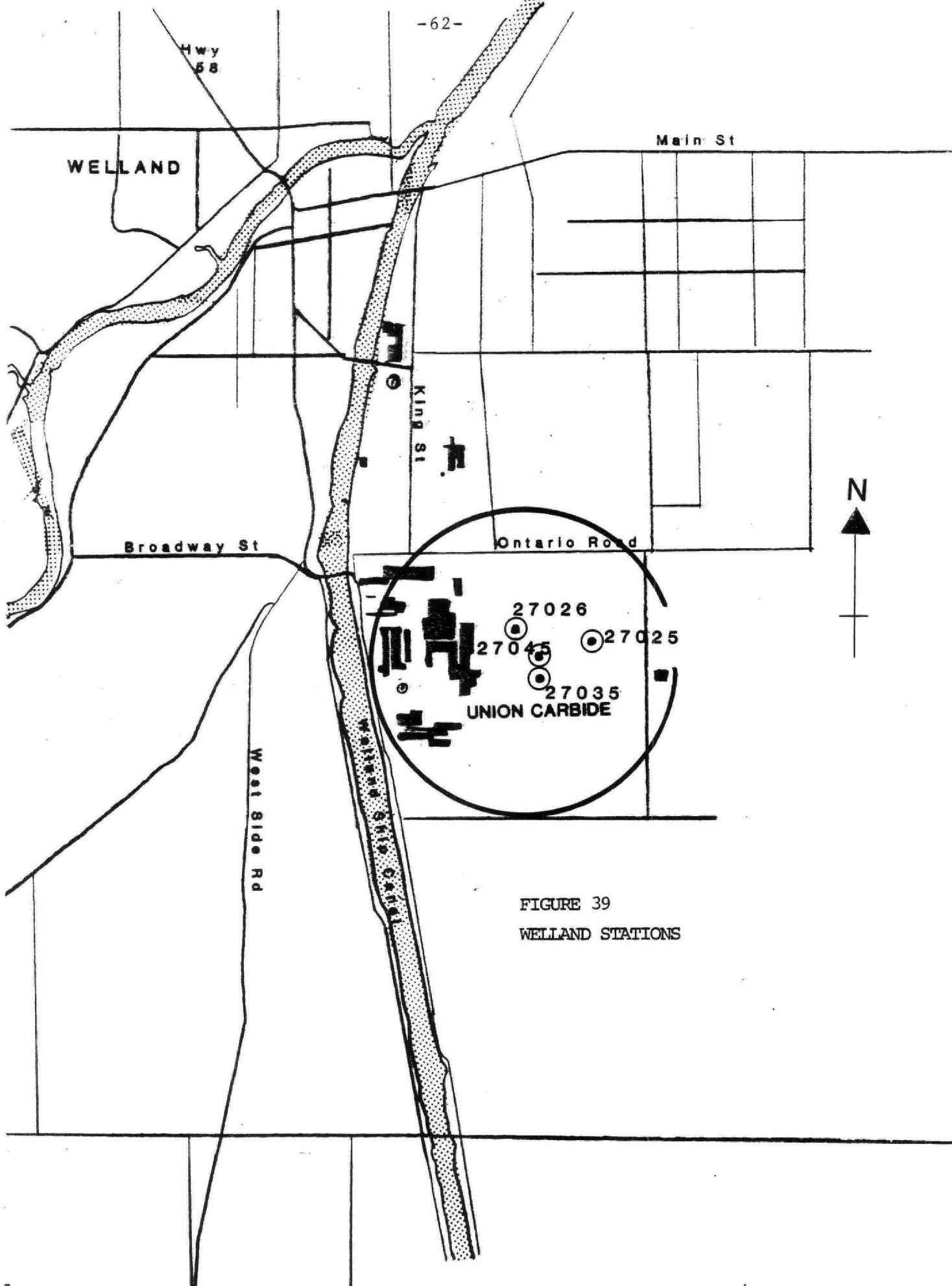


FIGURE 39  
WELLAND STATIONS

**TABLE 6**

**SUMMARY STATISTICS - WELLAND**

**PARTICULATES NEAR UNION CARBIDE LTD.**

SUSPENDED PARTICULATES - micrograms per cubic metre				ONT.OBJECTIVES: 120 (24 hour) 60 (annual geo.mean)				
STATION	GEOMETRIC MEAN			1987 MAXIMUM 24 HR	NO.OF SAMPLES	NO.TIMES OVER OBJECTIVE(1987)		SOURCE MONITORED
	1985	1986	1987			24 HR	1 YR	
27045 ALBERTA/DEVON	48	42	48	157	50	1	0	UNION CARBIDE

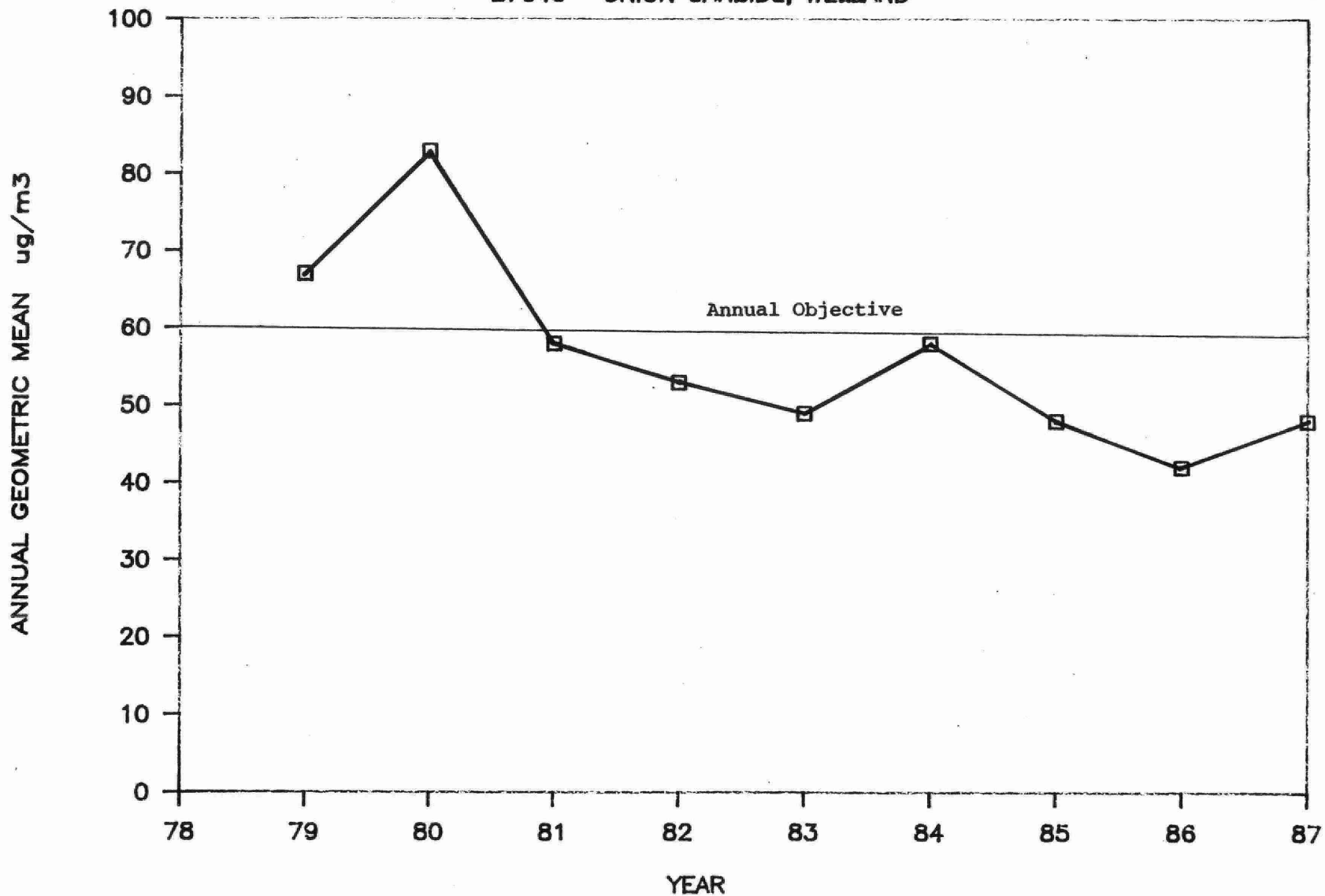
ELEMENTAL CARBON IN SUSP.PARTIC. - micrograms per cubic metre									
27045 ALBERTA/DEVON	3.3	3.1	3.0	10.5	50	No objective	UNION CARBIDE		

TOTAL CARBON IN SUSP.PARTIC. - micrograms per cubic metre									
27045 ALBERTA/DEVON	8.5	7.5	7.1	19.3	50	No objective	UNION CARBIDE		

DUSTFALL - grams/square metre/30 days				ONT.OBJECTIVES : 7.0(1 MONTH) 4.5(ANNUAL AVERAGE)				
STATION	ANNUAL AVERAGE			1987 MAXIMUM 1 MONTH	NO.MONTHS OVER OBJECTIVE			SOURCE MONITORED
	1985	1986	1987		1985	1986	1987	
27025 - HARRIET ST WELLAND	4.8	4.6	4.6	11.6	1	2	2	UNION CARBIDE
27026 - CHAFFEY ST WELLAND	4.9	4.4	3.7	6.5	2	2	0	UNION CARBIDE
27035 - ALBERTA ST WELLAND	7.4	9.9	7.6	16.8	5	9	5	UNION CARBIDE

# FIGURE 40 SUSPENDED PARTICULATES YEARLY TREND

27045 UNION CARBIDE, WELLAND

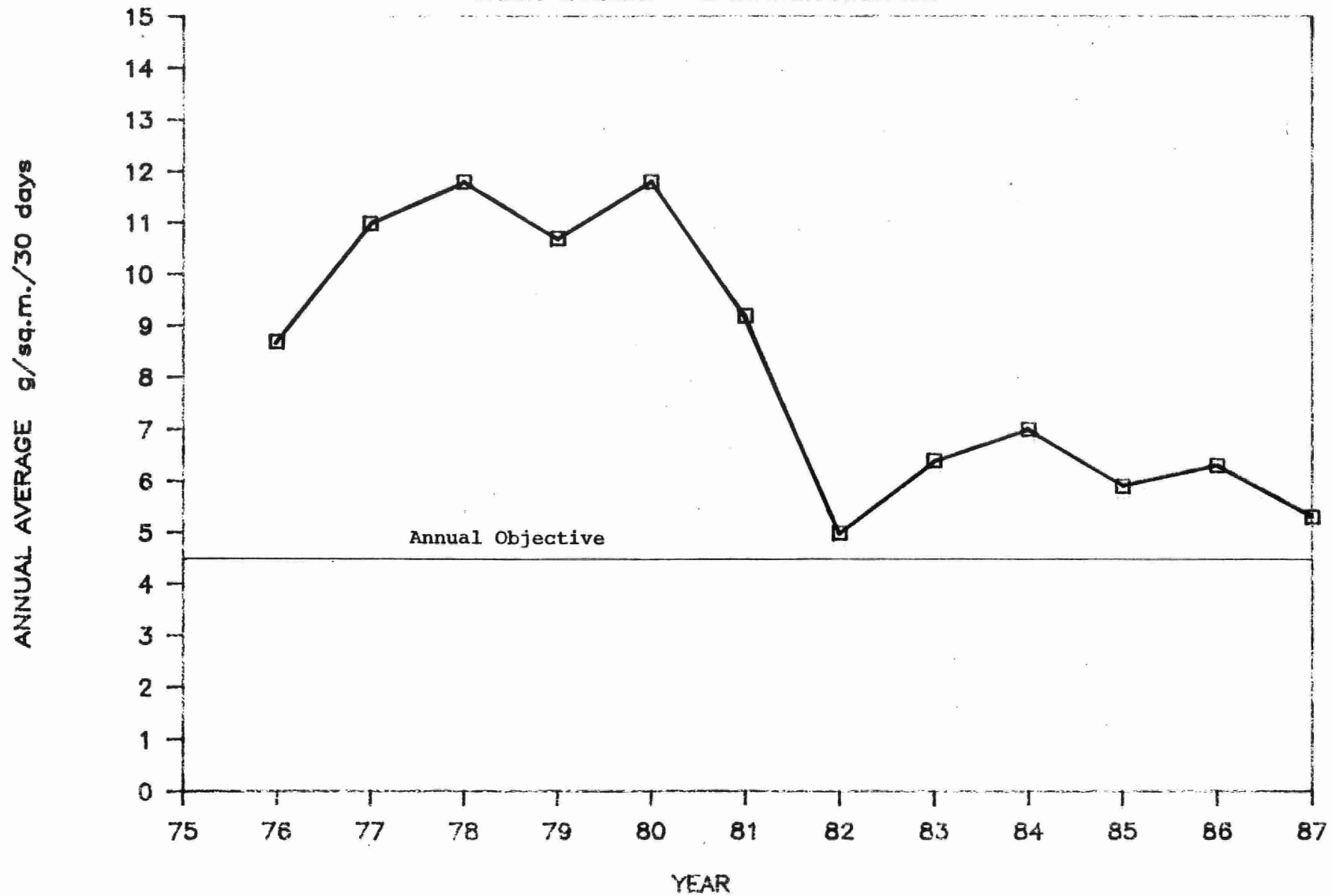


influence on the area. The major source of dust emissions are the carbottom furnaces. Numerous complaints of fallout are presently being investigated by the Ministry's Investigations and Enforcement Branch. The company has submitted a program to control dust emissions from the furnace operation by early 1989. Fugitive dust emissions from a landfill on company property are being addressed through seeding and dust suppression programs.

Dustfall in the area improved somewhat as shown in Table 6 due mainly to process modifications and various fugitive dust control efforts. One station, 27035 at the base of Alberta St. showed the greatest improvement. Five samples exceeded the monthly objective there compared to nine in 1986. This station is located near the landfill site mentioned above. The other two monitors (27025-Harriet St. and 27026-Chaffey St.) recorded much lower levels with two exceedences of the monthly objective between them, both at 27026. The trend graph in Figure 41 shows significant improvements have taken place since 1980 as a result of a number of abatement measures taken by Union Carbide.

FIGURE 41  
DUSTFALL YEARLY TREND — WELLAND

UNION CARBIDE 3 STATION AVERAGE



## DISCUSSION

This report has identified several local air pollution concerns in the Regional Municipality of Niagara. All are currently under investigation with a view to implementing control programs. Some control programs are already underway.

Apart from these localized problems, general air quality as characterized by the API (Air Pollution Index) stations in Niagara Falls and St. Catharines was very good. The advisory index level of 32 has never been exceeded at either of the two stations and both normally showed very low index readings, averaging 4 and 6 during 1987. They rarely exceed 20.

In 1988, a new air quality data telemetry system was installed and made operational throughout the Province. This new system permits all of the Ministry's stations with continuous analyzers to send data directly to a central computer facility in Toronto, allowing for data retrieval on a real-time basis. In the past, only the two API stations and the meteorological tower near Allanburg had this capability. Data from the remainder of the stations required manual reading of strip charts which caused delays of several months in the availability of data. The new system allows for immediate access to data, both in the Regional Office in Hamilton and in Toronto, and also allows for remote control and maintenance of the instruments. All of this results in a more efficient monitoring program.

The new telemetry system is being installed to facilitate a new and expanded Air Quality Index (AQI). The new AQI is a function of six different pollutants, which will form up to eight separate subindices. Concentrations of sulphur dioxide, soiling index, carbon monoxide, nitrogen dioxide, total reduced sulphur and ozone are all individually



converted to the old scale of index numbers with the same advisory or alert levels of 32, 50, 75 and 100. Not all stations will measure all of the parameters, but the highest subindex and the pollutant causing it will be reported several times daily to the public. In the Niagara Region, the new AQI will be reported for the St. Catharines (27067) and Niagara Falls (27056) stations. The new system has potential to add more communities in the future. The intent of the new index is to better inform the people of Ontario of air quality in their local area.